

Auditing Water Issues:
An Examination of SAIs'
Experiences and the Methodological
Tools They Have Successfully Used



INTOSAI
Working Group
on Environmental
Auditing



This publication was prepared by the INTOSAI Working Group on Environmental Auditing (WGEA). The WGEA aims to encourage the use of audit mandates and audit methods in the field of environmental protection and sustainable development by Supreme Audit Institutions (SAIs). The WGEA has the mandate to

- help SAIs gain a better understanding of environmental auditing issues,
- facilitate exchange of information and experiences among SAIs, and
- publish guidelines and other informative materials.

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FOREWORD & ACKNOWLEDGEMENTS

Given water's critical function in supporting human well-being, economic development, and environmental health, it is not surprising that water-related issues are often at the forefront of governmental actions in the environmental sphere. Likewise, Supreme Audit Institutions (SAIs) have devoted considerable resources and energy to auditing water-related issues, and water continues to serve as one of the central themes of the Working Group on Environmental Auditing (WGEA) of the International Organization of Supreme Audit Institutions (INTOSAI). Looking forward, the dynamic nature of water-related issues will likely become even more pronounced in light of the emerging issue of climate change. As governmental actions to address these challenges continue to develop and evolve, SAIs can expect to be called upon with greater frequency to help evaluate and improve their governments' responses to the critical water-related issues they face.

This report, developed by the SAI of the United States, is designed to showcase recent SAI experiences conducting audits in 11 key water issue areas, and to provide insights into the ways in which different audit tools can contribute to successful water-related audits. The report also updates and builds upon information presented in the WGEA's 2004 report prepared by the Netherlands Court of Audit titled, "Auditing Water Issues: Experiences of Supreme Audit Institutions." With a focus on the methodological tools used to conduct successful water-related audits, this report aims to assist SAIs in their pursuit of these audits, particularly those SAIs which may be new to the field.

We would like to acknowledge the efforts of the authors of this study from the SAI of the United States, including Nathan Anderson, Emily Eischen, Steven Elstein, and Joshua Wiener. Additional key contributions were provided by Celia Mendive, Alison O'Neill, Joshua Ormond, and Jeremy Sebest. Significant thanks are also owed to members of the WGEA Water Subcommittee for their assistance throughout this project, the WGEA Steering Committee for its thoughtful guidance and reviews, and to the many officials from SAIs around the world who graciously shared their water-related auditing experiences with the Project Team.



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ACRONYMS & ABBREVIATIONS

AGN –	Auditor General of the Nation of Argentina	OAG –	Office of the Auditor General (Botswana, Canada, and New Zealand)
ANAO –	Australian National Audit Office	OECD –	Organisation for Economic Co-operation and Development
DAFF –	Department of Agriculture, Fisheries and Forestry (Australia)	SAB –	State Audit Bureau of Kuwait
DEFRA –	Department for Environment, Food and Rural Affairs (United Kingdom)	SADC –	Southern African Development Community
EPA –	Environment Public Authority (Kuwait)	SAI –	Supreme Audit Institution
EU –	European Union	UN –	United Nations
EUROSAI –	European Organization of Supreme Audit Institutions	UNCCD –	United Nations Convention to Combat Desertification
GAO –	Government Accountability Office (United States)	UNDP –	United Nations Development Programme
GEMStat –	United Nations Global Environment Monitoring System	UNEP –	United Nations Environment Programme
GIS –	Geographic Information Systems	UNESCO –	United Nations Educational, Scientific and Cultural Organization
INTOSAI –	International Organization of Supreme Audit Institutions	UNICEF –	United Nations Children’s Fund
IPCC –	Intergovernmental Panel on Climate Change	WGEA –	INTOSAI Working Group on Environmental Auditing
KISR –	Kuwait Institute for Scientific Research	WHO –	World Health Organization
NAO –	National Audit Office (United Kingdom)	WS&PHED –	Sikkim Water Security and Public Health Engineering Department (India)
		WWAP –	United Nations World Water Assessment Programme

EXECUTIVE SUMMARY

This report aims to provide a comprehensive overview of critical water-related issues around the globe and the experiences of Supreme Audit Institutions (SAIs) in auditing their governments' responses to these issues. Water-related issues are among the most vexing challenges many governments face, with implications for human health, economic development, and environmental protection. Addressing these issues is often a difficult and complex endeavor, particularly in instances where governments must balance competing demands and interests while attempting to develop effective responses. The task is made even more challenging in situations where, as commonly occurs, water-related issues extend beyond national borders and require a multinational, coordinated response. This is particularly the case with water-related issues that are expected to be amplified by the emerging challenges presented by climate change. SAIs play a critical role in helping to evaluate and improve government responses to the water-related problems facing their nations.

Using the 2004 Working Group on Environmental Auditing (WGEA) report on auditing water issues¹ as a starting point, this report updates the results of this prior work and features an expanded focus on the methodologies SAIs have successfully used to audit a variety of key water-related issues. Specifically, this report examines:

- The status of critical water-related issues and the efforts made by governments and international institutions to respond to these issues;
- The status of SAIs' efforts to audit key water-related issues, and the approaches they have used to successfully analyze and report on their priority water challenges; and
- The usefulness of different methodological tools for auditing water-related issues and the circumstances in which these tools have proven to be particularly effective.

Based in large part on input provided by members of the WGEA Water Subcommittee and the WGEA Steering Committee, the scope of this report covers the following 11 water issue areas:

- Availability of Safe Drinking Water
- Competing Demands for Limited Water Supplies
- Drought
- Flooding
- Quality of Rivers, Lakes, and Other Surface Waters
- Marine Environment
- Planning and Financing for Drinking Water and Wastewater Infrastructure
- Implementation and Enforcement of Water Laws
- Challenges of Managing Water Resources Shared by Multiple Nations
- Adequacy of Water-Related Data
- Impacts of Climate Change on Water Resources

¹ INTOSAI Working Group on Environmental Auditing, *Auditing Water Issues: Experiences of Supreme Audit Institutions*, 2004.

The report is organized into 4 chapters, with Chapter 1 providing context for the report, explaining the Project's objectives, and explaining what the Project Team did to address them. Chapter 2 describes the 11 key global water issues and government efforts to address them. It notes that the water-related issues nations are facing have increased in urgency, and that their governments have often struggled to adopt necessary steps to adequately address them. *This challenge is particularly pronounced with water-related issues that may be amplified by the emerging issue of climate change, for which the anticipated impacts are expected to be severe yet efforts to mitigate or otherwise respond to these impacts are generally still in their early stages.*

Chapter 3 highlights the methods used, and the empirical results achieved, from 105 recent water-related audits published by SAIs from 43 countries. It provides an overview of the types of activities SAIs commonly audited in each of the 11 water issue areas and the approaches they took to do so. Whereas some water-related issues—such as the availability of safe drinking water—have received considerable attention from SAIs, other topics—such as the impacts of climate change on water resources—have only recently begun to gain prominence in the auditing community. *In this chapter, one audit from each water issue area is highlighted in an audit matrix, which in many cases feature insights obtained directly from the auditors that performed the evaluations. Audit matrices allow for comprehensive information to be presented on the key elements of the highlighted audits—including audit objectives, methodologies, and results—in an easily accessible format for other SAIs interested in conducting audits in the issue area.*

Chapter 4 presents an “Auditor’s Toolbox.” It examines the strengths and limitations of different audit methods when conducting water-related audits and, in particular, the circumstances in which SAIs have deemed them to be most useful. *Notably, the chapter shows that SAIs from developed and developing countries relied heavily on a core set of basic audit tools to complete most of the 105 audits.* These basic auditing tools include interviews, documentation review, site visits, surveys, case studies, and obtaining the assistance and opinions of external experts. The analysis presented in this chapter illustrates that these basic tools have been used by a wide range of SAIs with varying performance audit capabilities and experiences. In almost all cases, they provided the foundation for successfully auditing water-related issues. In some instances, however, SAIs supplemented the basic tools with the use of other more specialized audit methods to help substantiate findings or to address complex issues that required more specialized expertise or types of analysis. The specialized audit tools discussed in this chapter include expert panels, focus groups, database analyses, economic analyses, scientific analyses, and international benchmarking.

1.

INTRODUCTION

BACKGROUND

Water issues have long been a matter of great interest to WGEA members and have increasingly become a matter of growing concern to national governments and international institutions around the world. While the specific details of water-related problems vary across the globe, numerous common challenges have emerged that are shared by countries in all geographic regions of the world and affect both developed and developing nations. More specifically, challenges such as flooding, drought, and the availability of safe drinking water are widespread and often cross national boundaries, thus necessitating responses on both the national and international level. Furthermore, governments now also face the prospect that climate change will amplify many of the most difficult water-related issues impacting their countries.

In the face of these myriad water-related challenges, national governments and international institutions have responded by taking a wide variety of actions designed to mitigate the negative effects of these issues. SAIs can play an important role in improving government responses to water-related issues and ensuring that actions taken to address these challenges are successful. Accordingly, SAIs around the world have increasingly focused on these issues in their audit work, and a growing number of audit institutions continue to express interest in expanding their efforts in these areas.

In recognition of the growing importance of water-related issues to SAIs around the world, this report examines current key global water-related challenges and the role SAIs play in helping to address them through evaluations of their governments' activities. The Netherlands Court of Audit laid the groundwork for this project with its 2004 study titled, "Auditing Water Issues: Experiences of Supreme Audit Institutions." The study described the critical water issues facing the world at that time and catalogued existing efforts by SAIs to conduct audit work in these areas. This report seeks to update the results of the 2004 study to reflect how water-related issues have evolved and provide detailed insights on the methods SAIs have used to audit these issues.

1.1. OBJECTIVES

The project team addressed the following three objectives:

- To examine critical water-related problems facing nations around the globe and describe efforts by governments and international institutions to respond to these issues, paying particular attention to the water-related impacts of the emerging issue of climate change;
- To provide information on a wide variety of SAI water-related audits and evaluations, focusing in particular on the approaches SAIs have used to successfully analyze and report on their priority water challenges; and
- To evaluate the usefulness of different methodological tools for auditing water-related issues and identify circumstances in which the use of particular methods has proved to be effective.

1.2. SCOPE AND METHODOLOGY

To conduct this work, the project team reviewed studies on water-related issues published by international institutions and examined 105 audits conducted by 43 SAIs. Specifically:

Objective 1 (Presented in Chapter 2) – To examine the critical water-related issues facing nations around the world and to describe international efforts to respond to these issues, the Project Team:

- **Developed a list of priority water-related issues** based on literature published by well-regarded international organizations specializing in water issues, and in consultation with members of the WGEA Water Subcommittee and the WGEA Steering Committee. While the list of issues ultimately settled upon reflects the global diversity of water issues, and encompasses many of the most commonly shared water-related challenges nations currently face, it is not intended to include all water-related issues, nor to constitute a “best” list.
- **Reviewed and analyzed this literature, along with other documents** on these water-related issues; and
- **Obtained country-specific information** through analyses of national water-related audits and, in limited cases, direct contacts with officials from national environmental ministries.

Objective 2 (Presented in Chapter 3) – To provide information on SAIs’ water-related audits, with a particular focus on the approaches SAIs have used to audit water issues, the Project Team:

- **Analyzed and catalogued 105 water-related audits**, covering a range of water issues and with an emphasis on documenting their methodologies. These audits were published by SAIs from 43 countries located in all geographic regions of the world and reflect the experiences of SAIs from developed and developing countries. Audits were identified based on input provided by the 11 members of the WGEA Water Subcommittee² and other SAI partners, as well as through studies found on SAI websites and the WGEA website;
- **Obtained detailed information from specific SAIs** on their experiences conducting some of the audits included in this analysis. This information was obtained directly from SAI officials through interviews and questionnaires, and provided insights on, among other things, (1) the experiences that auditors have had using different methods, (2) the reasons why different methods were chosen for particular audits, and (3) the challenges auditors faced and the benefits they gained when employing different audit methods; and
- **Developed audit matrices** for one noteworthy audit from each water issue area to highlight the range of approaches SAIs have used to audit their priority water-related issues. Audit matrices are a tool commonly used by many SAIs to present information on the key elements of an audit and to effectively summarize an audit’s approach and methodology.³

Objective 3 (Presented in Chapter 4) – To evaluate the usefulness of different methodological tools for auditing water-related issues in a variety of circumstances, the Project Team:

- **Analyzed the 105 water-related audits** to determine which methodological tools had been successfully employed under which circumstances;
- **Analyzed the information obtained directly from SAI officials** for insights on the successes and challenges auditors had experienced using different methodological tools; and
- **Reviewed performance auditing literature and INTOSAI guidance documents** to complement and substantiate the results from the analysis of water-related audits and direct contacts with auditors.

² The 11 Subcommittee members are Cameroon, Canada, Chile, China, Egypt, Ecuador, Malaysia, New Zealand, Russia, Slovakia, and United States.

³ Audit matrices have generally been shown to be particularly effective when used as a planning tool by SAIs during the early stages of an audit investigation. However, as agreed upon with the WGEA Steering Committee at its meeting in Morocco in 2011, this report features a slightly modified version of the audit matrix that is designed to provide information on completed water-related audits.

2.

GLOBAL WATER CHALLENGES AND THE EFFORTS OF GOVERNMENTS AND INTERNATIONAL INSTITUTIONS TO ADDRESS THEM

OVERVIEW

The primary purpose of this chapter is to provide an updated assessment of water-related issues confronting nations around the world and to describe, at a high level, the types of actions being taken by select governments and multinational institutions to address these issues. Given the dynamic nature of global water issues, this information is intended to describe the evolving nature of these issues, and to provide a broad-based menu from which SAIs can identify their respective countries' highest priority activities and programs. This need is augmented by the growing prominence of emerging issues such as climate change, which is included as an area of focus in this chapter and is expected to significantly impact the scope and importance of water issues in the coming decades.

The information in this chapter is designed to illustrate the significance of different water-related issues and provide context for understanding the role of SAIs in their governments' efforts to address these critical issues. In this manner, the chapter sets the stage for chapters 3 and 4, which focus on the approaches SAIs have used to audit water issues and the circumstances in which different audit methods have proved to be most useful.

2.1. SELECTION OF WATER ISSUES

Building upon the results of the Netherlands' 2004 study and a review of international literature, the project team worked with members of the WGEA Water Subcommittee and incorporated feedback from the WGEA Steering Committee to identify a list of current priority water issues. In particular, the project team paid attention to ensuring that the issues were germane to different regions of the world and to both developed and developing countries. As noted in Chapter 1, although this list reflects the global diversity of water issues and encompasses many of the most commonly shared water-related challenges nations currently face or are likely to experience in the future, it is not intended to include all water-related issues, nor to constitute a "best" list. In addition, the issues on this list are not all mutually exclusive. The impact of climate change on water resources, for example, cuts across many of the other issue areas and often threatens to exacerbate challenges such as flooding and drought.

The remainder of this chapter is divided into subsections for each of the 11 current priority water issues identified by the Project Team in consultation with the WGEA Water Subcommittee and the WGEA Steering Committee. Within each subsection, a high-level description is provided of the water issue and the impacts it has produced around the world, as well as a brief examination of how different governments and international institutions have attempted to address these impacts under various circumstances. *A recurring theme throughout this chapter is that while the water-related issues facing nations around the globe are increasing in urgency, governments have often struggled to adopt necessary steps to adequately address them.*

2.2. KEY GLOBAL WATER ISSUES AND THE EFFORTS OF GOVERNMENTAL INSTITUTIONS TO ADDRESS THEM

2.2.1. AVAILABILITY OF SAFE DRINKING WATER

The principal water sources for direct human consumption, including lakes, rivers, and shallow groundwater basins, account for less than 1 percent of the total volume of water on earth and are often at risk for contamination.⁴ Ensuring that sufficient quantities of safe drinking water are available and effectively delivered to the people who need it is a critical responsibility for governments throughout the world and is one of the most important water-related functions that governments perform. The types of challenges involved in ensuring safe drinking water supplies vary greatly among nations, and encompass threats to both the quality and quantity of drinking water.

According to a 2012 report issued by the United Nations Children's Fund (UNICEF) and the World Health Organization (WHO), 89 percent of the world's population gets their drinking water from improved sources that are protected from outside contamination, including 86 percent of people in developing countries.⁵ However, that means approximately 780 million people still do not get their drinking water from improved sources. This problem is particularly pronounced in certain regions of the world, most notably in sub-Saharan Africa where UNICEF and WHO estimate that only 61 percent of the population has access to improved sources of water. In addition to geographic disparities in drinking water coverage, there are also significant differences in the levels of access to safe drinking water between urban and rural populations. Specifically, UNICEF and WHO reported in 2012 that the number of people in rural areas still using unimproved water sources was approximately five times greater than the number of people doing so in urban areas (see fig. 1).

⁴ United Nations Environment Programme (UNEP), *Global Environment Outlook 4: Environment for Development* (Valletta, Malta: Progress Press Ltd., 2007).

⁵ UNICEF and World Health Organization (WHO), *Progress on Drinking Water and Sanitation: 2012 Update* (United States of America, 2012).

Figure 1: Millions of People Around the World—Such as these School Children in India—Lack Easy Access to Safe and Secure Drinking Water Supplies



Source: Comptroller and Auditor General of India ⁶

The global significance of drinking water issues and efforts to address them was embodied in the United Nations' (UN) Millennium Development Goals, which established a target for reducing by half the proportion of people without sustainable access to safe drinking water by 2015. UNICEF and WHO announced in 2012 that this goal had been achieved ahead of schedule, but significant work remains to be done in order to achieve universal coverage and to help the millions of people who still do not have access to safe drinking water. International aid plays a prominent role in global efforts to improve access to drinking water, especially given the heavy reliance that many developing countries have on foreign donations for their drinking water investments. For example, a 2010 WHO report sponsored by UN-Water⁷ noted that nearly 90 percent of Mozambique's total investment in sanitation and drinking water in 2008 consisted of aid received from a variety of international donors.⁸ Donors included individual countries (such as the Netherlands and Sweden) and international institutions (such as the World Bank), and the donated funds were used to improve water supply and sanitation services in both urban and rural areas.

2.2.2. COMPETING DEMANDS FOR LIMITED WATER SUPPLIES

Growing populations, together with the goal of fostering economic development, have increasingly led to situations in which alternative goals are in direct competition for finite water supplies. Worldwide, competing demands over water needs for human consumption, energy, agriculture, and industry have led to difficult policy decisions—and often to direct conflict between competing interests and entities (see fig. 2). Conflicts about water occur at all scales, including at the local level where farmers may compete with each other for water in irrigation systems, as well as at the state, national, or even international levels over water bodies that cross political boundaries (such as the Colorado River in the United States and Mexico).

⁶ Comptroller and Auditor General of India, *Performance Audit of the Accelerated Rural Water Supply Programme*, 2008. (Note: this audit report can be obtained from the SAI's [website](#))

⁷ UN-Water is an inter-agency mechanism established by the UN in 2003 to strengthen coordination and coherence among all UN bodies dealing with water-related issues.

⁸ World Health Organization, *UN-Water Global Annual Assessment of Sanitation and Drinking-Water 2010: Targeting Resources for Better Results* (Geneva, Switzerland: UN-Water, 2010).

Figure 2: Diverting Water for Oil Shale Development (Such as this Surface Retort in Colorado) Could Limit the Amount of Water Available for Agricultural and Urban Development in Parts of the United States



Source: United States Government Accountability Office.⁹ Photo by Shale Technologies, LLC.

Nevertheless, as demands for water increase around the globe, in many locations the amount of available water to meet those demands has decreased. Oftentimes, this challenge is exacerbated by the impacts of some of the other priority water issues discussed in this report, such as drought, which can reduce available water supplies. Similarly, degradation in the quality of surface water and groundwater due to water pollution can increase water scarcity—and thus heighten the risks for conflict between competing demands for water—by rendering water unfit for certain uses.¹⁰

The scope of this issue area is not limited to competing demands between human interests for limited water supplies, but rather also covers challenges associated with balancing consumptive water needs with the hydrologic needs of the environment and different natural ecosystems. According to the UN World Water Assessment Programme, the extraction of water has approached, and in some cases exceeded, the threshold of renewability of water resources in many river basins, resulting in widespread damage to ecosystems. The environmental effects of competing demands for water supplies are also often evident in regard to hydroelectric power and the harm that dams can cause to fisheries by impeding fish migrations.

Governments have typically responded to the competing demands for water supplies in their nations through a mixture of three different approaches. First, some governments have sought to increase the supply of water available to meet water demand by, for example, building new reservoirs or moving water from river basins with lower levels of demand to basins with greater water demands. Other countries with very limited water resources, such as Israel and Egypt, have also begun to supplement their water supplies by reusing urban wastewater in agriculture.¹¹ Second, many governments have focused on increasing the efficiency of water usage in their countries by, for example, using economic incentives and volumetric water pricing to reduce water demand. Third, some governments have developed arrangements to re-allocate water resources among different sectors. At the international level, this has often involved the establishment of treaties or other formal agreements between countries, while at the national level water re-allocation is sometimes achieved through the use of water trading markets. For instance, in locations that have established water trading regimes (such as Chile and parts of Australia), farmers have used water markets to purchase supplementary water during drought conditions and cities have purchased water rights from farms or other properties to help meet their growing water needs.¹²

⁹ United States Government Accountability Office, *Energy-Water Nexus: A Better and Coordinated Understanding of Water Resources Could Help Mitigate the Impacts of Potential Oil Shale Development*, GAO-11-35 (Washington, D.C., 2010). (Note: this audit report can be obtained from the SAI's [website](#))

¹⁰ United Nations (UN) World Water Assessment Programme (WWAP). *The United Nations World Water Development Report 3: Water in a Changing World* (Paris, France: UNESCO, and London, United Kingdom: Earthscan, 2009).

¹¹ UN WWAP, *The United Nations World Water Development Report 3: Water in a Changing World*, 2009.

¹² UN WWAP, *The United Nations World Water Development Report 3: Water in a Changing World*, 2009.

2.2.3. DROUGHT

Many countries are already affected by serious drought conditions during many months of the year. Projected increases in temperature and decreases in precipitation associated with climate change, compounded by early snowmelt, are expected to exacerbate the problem in many parts of the world. Severe droughts have been shown to produce wide ranging negative impacts, including economic (e.g., reduced agricultural production), social (e.g., increased stress on farming families and rural communities), and environmental (e.g., damage to wetlands and other important ecosystems from reduced water flows) harm (see fig. 3). A study by the International Water Management Institute found that countries with largely agricultural economies are generally more vulnerable to the adverse impacts of drought than countries with more diversified economies. In particular, the more complex economies of developed countries are typically better positioned to insulate their populations from fluctuations in agricultural productivity due to drought compared to the more agrarian economies of many developing nations.¹³

Figure 3: Dead Fish from a Lake in Texas in the United States that Recently Experienced Severe Drought



Source: U.S. Geological Survey. Photo by Travis Dowell.

Since humans cannot control the meteorological conditions that primarily dictate when and where droughts occur, most governments have instead focused on taken action to reduce the adverse effects of drought when they happen. Australia, for instance, has repeatedly experienced severe and prolonged periods of drought. According to information provided by officials from Australia's Department of Sustainability, Environment, Water, Populations and Communities, the Australian government has implemented a variety of actions designed to mitigate the effects of drought and limit the harm future droughts will cause. For example, the government provided financial assistance to farmers impacted by drought and has purchased additional water for delivery to rivers and lakes to protect environmental priorities threatened by drought conditions. The Australian government has also established a policy framework to guide these and other efforts to address the impacts of drought and ensure the future sustainability of water supplies, lead by the National Drought Policy created in 1992, the 2004 National Water Initiative, and the *Water for the Future* plan.

¹³ Eriyagama, N.; Smakhtin, V.; Gamage, N. *Mapping Drought Patterns and Impacts: A Global Perspective* (Colombo, Sri Lanka: International Water Management Institute, 2009).

At the global level, the United Nations Convention to Combat Desertification (UNCCD) is a leading international effort designed to address and mitigate the negative impacts of drought. Since being established in 1994, the UNCCD has been ratified by more than 190 countries and seeks to reverse and prevent desertification and land degradation in dry, arid, and semi-arid locations, and to mitigate the effects of drought in affected areas.¹⁴ Along with various human activities, drought is often a key contributor to desertification and land degradation. Under the UNCCD, funding and international aid is targeted to vulnerable regions and is used, among other things, to support sustainable land management practices and to enhance communities' resilience to drought and other threats associated with water scarcity and land degradation.¹⁵

2.2.4. FLOODING

While some regions suffer from chronic drought, others are primarily concerned with flooding. Here too, projected impacts associated with climate change may worsen the current situation, leading to floods of greater magnitude and frequency. Overall, the frequency and severity of damaging flood events in many countries have already increased in recent years.¹⁶ While it is difficult to determine the extent to which changes in the climate may be contributing to this increase, it is well documented that human activities at the local level—particularly development in flood-prone areas—have impacted water flows and exposed greater numbers of people to flooding dangers (see fig. 4). In addition to inundating susceptible areas, flooding often affects water quality as well, as large volumes of water can transport contaminants into water bodies and also overload stormwater and wastewater systems.

Figure 4: Floodwaters Impacting Babati Town in Tanzania in 1990



Source: National Audit Office of Tanzania¹⁷

¹⁴ United Nations, "An Introduction to the United Nations Convention to Combat Desertification," United Nations Convention to Combat Desertification (UNCCD) Fact Sheet 1, accessed March 15, 2012, http://www.unccd.int/Lists/SiteDocumentLibrary/Publications/factsheets/Fact_sheet_01eng.pdf.

¹⁵ United Nations, "Water Scarcity and Desertification," UNCCD Thematic Fact Sheet Series No. 2, accessed March 15, 2012, <http://www.unccd.int/Lists/SiteDocumentLibrary/Publications/Desertificationandwater.pdf>.

¹⁶ Organisation for Economic Co-operation and Development (OECD), *OECD Environmental Performance Reviews – Water: The Experience in OECD Countries*, 2006.

¹⁷ National Audit Office of Tanzania, *A Performance Audit of the Management and Mitigation of Floods at Central, Regional and Local Levels of the Government of Tanzania: A Case Study of Floods in Babati*, 2007. (Note: this audit report can be obtained from the WGEA [website](#))

Despite efforts taken to prevent and protect against flooding, many floods still result in considerable loss of human life and produce significant material and financial losses. According to the Organisation for Economic Co-operation and Development (OECD), 10 out of the 40 most costly disasters in terms of insured losses from 1970 to 2005 involved floods. Similarly, a 2009 report from the UN World Water Assessment Programme found that economic losses from flood disasters have greatly increased in recent decades.¹⁸ Notably, both reports identified population growth, land use changes, and increased human activities in areas vulnerable to flooding as some of the key factors that have contributed to the greater severity of damaging flood events. In fact, some recent high-profile floods have produced such widespread devastation as to require a coordinated international relief and recovery effort. Pakistan, for example, experienced severe flooding in the summer of 2010 that resulted in the deaths of nearly 2,000 people and damaged or destroyed more than 1 million houses. The global community launched a multi-faceted response to assist the nation during this disaster, including providing direct support in the form of rescuing people trapped by the floods, delivering relief supplies and food, and securing more than \$2 billion dollars in international donations.¹⁹

Governments have generally responded to the threats posed by flooding by taking several different types of action. For instance, many governments have focused on installing flood defense and protection measures in an effort to prevent floods from occurring. Likewise, to improve their abilities to predict and respond to the extreme weather events that cause floods, some governments have invested in strengthening their climate and weather forecasting capabilities. In addition, some governments have also begun to integrate flood risk management into land use planning by, for example, establishing tighter planning guidelines to discourage building on flood plains. Finally, many developed countries have also established systems of flood insurance or other types of compensation payments to help people and businesses recover from damaging flood events.²⁰

2.2.5. QUALITY OF RIVERS, LAKES, AND OTHER SURFACE WATERS

Economic development and industrialization have led to greater threats of surface water contamination that can directly harm human health and aquatic life, as well as reduce the availability of water for agriculture, recreation, and other purposes. Many countries have struggled to effectively use their fresh water resources in support of their economic expansion efforts in a way that also protects the quality of these resources, a tradeoff that poses particular challenges to governments in the developing world. Furthermore, since most polluted fresh water eventually ends up in the oceans, the deteriorating quality of many surface waters has also caused serious damage to many coastal areas and fisheries.

Common sources of fresh water impairment around the globe include untreated sewage, industrial runoff, chemical discharges, petroleum leaks and spills, and agricultural chemicals and manure that are washed off from farm fields (see fig. 5). Specifically, the United Nations Environment Programme (UNEP) reports that nutrient enrichment has become the planet's most widespread water quality problem and is most often associated with nitrogen and phosphorus from agricultural runoff, as well as human and industrial wastes.²¹ Shifts in land usage and changes in spatial planning also impact surface water quality and can affect hydrological cycles, particularly as more land is removed from its natural state for use in agriculture or other types of development. In addition, higher water temperatures and changes in the timing, intensity, and duration of precipitation can also deteriorate the quality of rivers, lakes, and other surface waters.

¹⁸ UN WWAP, *The United Nations World Water Development Report 3: Water in a Changing World*, 2009.

¹⁹ Elizabeth Ferris and Daniel Petz, *A Year of Living Dangerously: A Review of Natural Disasters in 2010* (Washington, D.C., USA: The Brookings Institution – London School of Economics Project on Internal Displacement, 2011).

²⁰ OECD, *OECD Environmental Performance Reviews – Water: The Experience in OECD Countries*, 2006.

²¹ United Nations Environment Programme (UNEP) and Pacific Institute, *Clearing the Waters: A Focus on Water Quality Solutions* (Nairobi, Kenya: United Nations, 2010).

Figure 5: Toxic Chemicals from Abandoned Mines—Such as Those in the Discolored Water Emanating from this Old Coal Mine in the United States—Are a Common Source of Water Pollution in Mining Areas



Source: United States Government Accountability Office. Photo by Joshua Wiener.

Many developed nations have made significant progress in reducing direct discharges of pollutants into water bodies—primarily through increased treatment of industrial wastewater—but are still experiencing difficulties managing a wide variety of emerging contaminants that are being introduced into waters.²² Amongst the most prominent of these emerging contaminants are endocrine disrupting chemicals—such as the chemicals used in pharmaceuticals like birth control pills— which can interfere with hormone action and have been shown to produce harmful effects in wildlife exposed to these chemicals in the water. Developed nations have also continued to struggle in addressing diffuse, or “non-point”, sources of water pollution that are not easily identifiable and occur when runoff carries pollutants from agricultural land and urban streets into nearby water bodies.

In response to the water pollution problems facing their nations, developed nations have typically implemented a variety of laws, regulations, and programs designed to either penalize polluters or incentivize the adoption of practices and behaviors that will reduce water pollution. In some instances, multinational bodies have helped to strengthen individual national and local laws and policies by adopting regional framework agreements that establish water quality standards for their participating member states. For example, the European Union’s (EU) Water Framework Directive obliges EU member states to achieve “good” ecological status in all of their waters by 2015 and established shared water criteria and standards that member states must adhere to in order to achieve this goal.²³

Surface water quality problems are generally even more severe in developing countries, where industrial wastes often receive no treatment before being discharged into water and the lack of adequate basic sanitation results in significant water quality contamination. For example, in 2009 the United Nations World Water Assessment Programme estimated that over 80 percent of the sewage in developing countries was discharged untreated into receiving water bodies.²⁴ Governments and international institutions have adopted a wide variety of approaches to improving surface water quality in developing nations. These include, amongst others, funding the installation of decentralized wastewater treatment systems that treat individual homes or business, and launching educational efforts to raise awareness about proper sanitation and waste disposal practices in impoverished communities.

²² UNEP and Pacific Institute, *Clearing the Waters: A Focus on Water Quality Solutions*, 2010.

²³ UNEP and Pacific Institute, *Clearing the Waters: A Focus on Water Quality Solutions*, 2010.

²⁴ UN WWAP, *The United Nations World Water Development Report 3: Water in a Changing World*, 2009.

2.2.6. MARINE ENVIRONMENT

Across the globe, oceans are threatened by a variety of pressures resulting from human activities, including the over-exploitation of fish and other marine wildlife, pollution of the marine environment, and coastal habitat loss. Different sectors of human activity are responsible for these threats that contribute to marine and coastal degradation and the depletion of fish stocks occurring in oceans and seas around the world. Furthermore, looming in the future are predictions for sea level rise resulting from climate change—a problem that some countries are already experiencing.

According to the UNEP, several direct pressures contribute to the overexploitation of fish stocks and other marine mammals. For example, human population growth and increased wealth have prompted significant increases in fish catch in recent decades. Likewise, technological advances have allowed fishing fleets to catch larger quantities of fish with greater precision and efficiency, including in more remote and deeper waters that had been difficult to fish in the past. The exact future impacts of climate change on fisheries remain unknown, but there is evidence to suggest that the anticipated changes in water temperature and wind patterns due to climate change may produce potentially serious impacts on global fishery resources.²⁵

Pollution in the marine environment generally comes from two sources. First, most river systems eventually drain into oceans or seas, and in doing so deposit the pollution they have accumulated over the course of their journey over land into the marine environment. Second, oil spills and the release of other types of pollution from ships sailing at sea can be another important cause of marine pollution (see fig. 6). Coastal zones are considered to be at particular risk from pollution in the marine environment. Notably, marine pollution can lead to significant destruction of coastal ecosystems and habitats, which subsequently affects humans who rely on these ecosystems for their livelihoods and can cause human health problems (e.g., due to contaminated shellfish).²⁶ Similarly, pollution in the marine environment has also contributed to toxic algal blooms and oxygen-depleted 'dead zones' that harm marine life and threaten biodiversity and fisheries.

Figure 6: The Explosion of the *Deepwater Horizon* Drilling Unit in the Gulf of Mexico in 2010 Resulted in the Largest Oil Spill in the United States' History and Produced Severe Environmental Consequences



Source: U.S. Coast Guard.

²⁵ UNEP, *Global Environment Outlook 4: Environment for Development*, 2007.

²⁶ UNEP and Pacific Institute, *Clearing the Waters: A Focus on Water Quality Solutions*, 2010.

In addition to individual national actions, this issue area has featured a broad array of collaborative and international responses by governments impacted by problems in the marine environment. For example, since 1974 the UNEP's Regional Seas Programme has promoted cooperation between neighboring countries to protect their shared marine environment. Specifically, the Regional Seas Programme has helped to develop and coordinate 18 Regional Seas Conventions (such as the Helsinki Convention covering the Baltic Sea) and Action Plans involving more than 140 countries. Among other things, the Regional Seas Conventions and Action Plans are designed to provide a regional cooperation framework that mobilizes countries to address transboundary marine issues (such as depleted fish stocks in shared waters), improve management of coastal zones, and reduce pollution in coastal waters.²⁷

2.2.7. PLANNING AND FINANCING FOR DRINKING WATER AND WASTE-WATER INFRASTRUCTURE

Drinking water systems and wastewater collection and treatment facilities are critical elements of the infrastructure of most nations. Large sums of money are often needed to support capital construction, maintenance, and eventual replacement of these facilities. Whereas developed countries often focus on financing centralized drinking water and wastewater infrastructure systems (such as large treatment plants), the infrastructure needs in many developing countries are often more basic and may require a more decentralized approach. In some countries, the need for smaller facilities to serve remote areas presents other challenges as well.

In addition to financing new water-related infrastructure, investing in the operation and maintenance of existing infrastructure is crucial to ensure that it continues to meet established standards and functions effectively. Nevertheless, abundant evidence suggests that operations and maintenance are neglected nearly everywhere in favor of new infrastructure investments, regardless of a country's level of development.²⁸ Insufficient maintenance can, and often does, result in drinking water infrastructure deteriorating to the point where it can no longer provide reliable access to safe drinking water for the population it is intended to support. This problem is particularly pronounced in impoverished rural areas in some developing countries, where inadequate funding and neglect of maintenance activities often contribute to widespread non-functionality of water-related infrastructure. For example, a 2009 report by the UN WWAP highlighted a study of nearly 7,000 rural water schemes in Ethiopia that found between 30% and 40% of the schemes were non-functional.²⁹ Similarly, inadequate maintenance has also contributed to the deterioration of wastewater infrastructure in numerous countries, many of which have subsequently seen municipal water utilities become the main polluters of surface waters as a result.

As evidenced by the approximately 780 million people that do not have access to improved drinking water sources and the estimated 2.5 billion people that do not have access to adequate sanitation facilities, the need to improve water-related infrastructure around the world is great.³⁰ The notable discrepancy between the levels of access to safe drinking water compared to adequate sanitation can be explained, in part, by the fact that countries typically invest far more on supplying water than on sanitation needs.³¹ In the case of developing countries, investments in wastewater treatment facilities generally fail to keep up with population growth, leaving most wastewater untreated. As a result, the UN WWAP estimated in 2009 that over 80 percent of the sewage in developing countries was discharged untreated into water bodies.³²

²⁷ United Nations Environment Programme, "Regional Seas Conventions and Action Plans," UNEP Regional Seas Programme Fact Sheets, accessed March 15, 2012, <http://www.unep.org/ecosystemmanagement/Portals/7/Documents/factsheets/RSCAPs%20FactSheet%20web.pdf>

²⁸ UN WWAP, *The United Nations World Water Development Report 3: Water in a Changing World*, 2009.

²⁹ UN WWAP, *The United Nations World Water Development Report 3: Water in a Changing World*, 2009.

³⁰ UNICEF and WHO, *Progress on Drinking Water and Sanitation: 2012 Update*, 2012.

³¹ UNEP and Pacific Institute, *Clearing the Waters: A Focus on Water Quality Solutions*, 2010.

³² UN WWAP, *The United Nations World Water Development Report 3: Water in a Changing World*, 2009.

Acquiring sufficient funding and technical expertise to establish and maintain sufficient drinking water and wastewater infrastructure in a cost-effective manner is a challenge shared by many nations. This challenge is made even more difficult by the fact that water investments generally produce low returns and require long payback periods. Within this context, countries generally secure financing for their water-related infrastructure needs through four different approaches. First, the most common source of financing for water-related infrastructure needs is direct public expenditures by the government. According to the UNDP, public expenditures account for more than 70% of total global investments in the water sector.³³ Second, governments also often raise funds for developing and maintaining water infrastructure by charging fees or tariffs to users and beneficiaries of the infrastructure. Nevertheless, user fees for water are often underpriced, which deprives the water sector of essential funds and contributes to underinvestment in water infrastructure maintenance and development.³⁴ Third, some governments—particularly those in the developing world—use external financial aid donated by other countries and by non-governmental philanthropic sources to help finance investments in drinking water and wastewater infrastructure (see fig. 7). However, donors have generally shown greater interest in financing new infrastructure rather than supporting maintenance activities, which may present challenges for countries trying to secure external funding to support their water infrastructure maintenance needs.³⁵ Finally, the private sector is also involved in providing water-related services and financing the infrastructure necessary to do so in some countries, though the global extent of private water services remains relatively small compared to the role of the public sector.

Figure 7: A South African Woman Drinks from a Water Pump Installed with the Support of International Aid to Help Deliver Clean Water to Rural Villages



Source: United States Agency for International Development, photo by Reverie Zurba

³³ United Nations Development Programme, *Human Development Report 2006 – Beyond Scarcity: Power, Poverty, and the Global Water Crisis* (Basingstoke, United Kingdom and New York, USA: Palgrave Macmillan, 2006).

³⁴ UN WWAP, *The United Nations World Water Development Report 3: Water in a Changing World*, 2009.

³⁵ UN WWAP, *The United Nations World Water Development Report 3: Water in a Changing World*, 2009.

2.2.8. IMPLEMENTATION AND ENFORCEMENT OF WATER LAWS

Most nations have laws designed to ensure a proper allocation of limited water resources and to ensure their quality. Such laws, however, can only have their intended effect if properly enforced. Countries have taken a variety of approaches to implement and enforce water laws, policies, and regulations. According to the UNEP, in countries where legal systems exist, governments often use fines or other legal penalties issued through the court system to ensure compliance with water laws (see fig. 8).³⁶ Some governments also withhold public funds from violators as a strategy to compel compliance with water laws since many private sector polluters (such as industries) often benefit from some form of public funding, such as loan programs or tax breaks. Conversely, rather than focus exclusively on direct enforcement to accomplish water goals, some governments also utilize market-based mechanisms, such as water trading schemes, to achieve desired water-related outcomes.

Figure 8: Adequately Enforcing Fishing Regulations and Other Water-Related Laws is Crucial for Protecting Water-Related Resources



Source: U.S. Fish and Wildlife Service

Nevertheless, the UNEP has also noted that many factors, such as social or political instability and limitations in a government's capacity or resources for compliance activities, may impede the enforcement of water laws, leading to violations and an inability to accomplish water-related goals.³⁷ Corruption has also been identified as a significant problem in the water sector that inhibits the ability of governments to effectively implement and enforce water-related policies and laws. In particular, corruption in water-related construction projects, such as sewer systems and wastewater treatment plants, has been problematic in many developing countries, which often have more limited oversight capabilities to ensure the efficient use of public resources.³⁸

³⁶ UNEP and Pacific Institute, *Clearing the Waters: A Focus on Water Quality Solutions*, 2010.

³⁷ UNEP and Pacific Institute, *Clearing the Waters: A Focus on Water Quality Solutions*, 2010.

³⁸ UN WWAP, *The United Nations World Water Development Report 3: Water in a Changing World*, 2009.

Water resource licensing has become an integral part of water resources management and a key tool for implementing and enforcing water policies in certain parts of the world. Licensing and other allocation mechanisms are important because they help determine who gets access to water, and they provide a mechanism to manage water fairly, efficiently, and sustainably. However, in many countries the potential for corruption in water licensing is an important issue as well. For example, in a 2009 report sponsored by the United Nations Development Programme (UNDP), researchers found that water licensing policies are often hampered by local realities, including dated infrastructures with low levels of monitoring, control mechanisms, and generally a lack of data to ensure equitable resource distribution and law enforcement.³⁹

In short, much water use and pollution remains unlicensed and unregulated. The report looked at water resource management in Chile and Kazakhstan as case studies, and found that in both the market-oriented (Chile) and state-oriented (Kazakhstan) water licensing systems, the potential for corruption existed. In part, this risk was attributed to the fact that water licensing in each country was administered by under-funded, under-equipped, and inadequately coordinated regulating agencies.

2.2.9. CHALLENGES OF MANAGING WATER RESOURCES SHARED BY MULTIPLE NATIONS

According to a 2009 UNDP report, there are 263 river basins that cross the political boundaries of two or more countries.⁴⁰ These basins represent about one half of the earth's land surface and are home to 40 percent of the global population. Further, most of the world's fresh water is stored in groundwater or glaciers, which are also often shared between countries. Specifically, the UNDP report estimated there are 300 transboundary aquifer systems in the world.

Managing shared water resources presents unique challenges to the countries involved and may create situations in which different incentives exist between upstream and downstream governments for how to use and protect these resources. For instance, waters that cross national borders can carry pollution from upstream to downstream countries, and upstream users can threaten the quality and quantity of water available for those living downstream by extracting too much water from a shared river. The UNDP report cites the example of the border town of Malaba in Kenya, where adequate sanitation facilities are not available for truck drivers waiting customs clearance. The truck drivers instead use plastic bags to dispose of wastes, which are then deposited into a nearby river. Consequently, this pollution problem is then passed downstream to the Ugandan population.

Flooding is another common area of concern for countries that share a water body, as actions taken in upstream countries can potentially contribute to damaging flood events in downstream nations. The UNDP report notes that this situation has occurred in Bangladesh, for example, where flooding has been exacerbated by land use changes in upstream Himalayan countries.

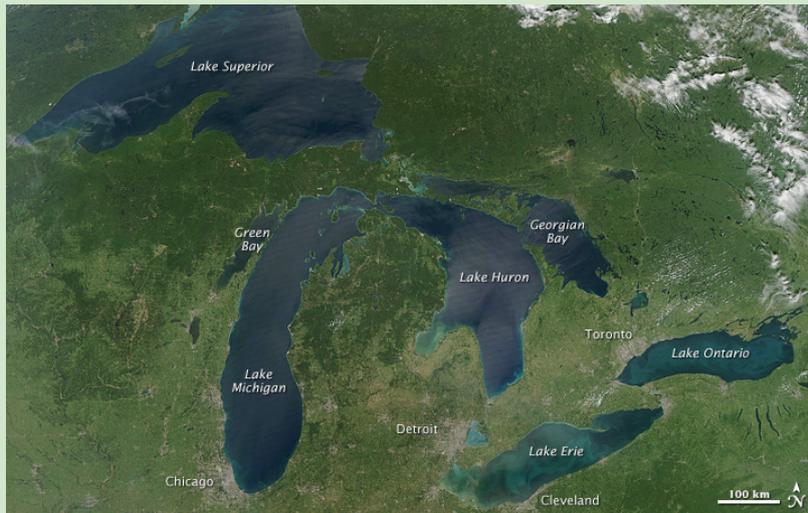
The unique challenges posed by shared water resources can generally best be met by cooperative actions among the relevant governments. There are many examples of international cooperation to manage and protect water resources, both in terms of formal agreements between nations and instances where governments work together to resolve immediate shared water problems (see fig. 9). For example, the UNDP found that more than 300 international water agreements had been reached in the 60 years prior to its 2009 report.⁴¹ In addition to formal agreements and treaties, governments have also collaborated together to resolve urgent problems occurring in shared water bodies, such as acute flooding events or pollution spills impacting multiple nations. For instance, in 2005, a chemical explosion at Jilin in northern China caused 100 tonnes of benzene to enter the Songhua River, a tributary of the Amur River on the Russian border. In recognition of the risk this spill posed to its Russian neighbors, China notified the Russian authorities in time for them to close down water supplies to border villages, and provided labor and materials to help protect the water supply of the Siberian city of Khabarovsk.

³⁹ Warner, J., Butterworth, J., Wegerich, K., Mora Vallejo, A., Martinez, G., & Gouet, C. and Visscher, J.T. *Corruption Risks in Water Licensing with Case Studies from Chile and Kazakhstan*. Swedish Water House Report 27. (Uppsala, Sweden: Stockholm International Water Institute, 2009).

⁴⁰ United Nations Development Programme (UNDP), *Water Supply in Shared Waters* (Sweden, 2009).

⁴¹ UNDP, *Water Supply in Shared Waters*, 2009.

Figure 9: The United States and Canada Have Established Formal Agreements and Developed Shared Institutions to Help Coordinate their Joint Management of the Great Lakes



Source: NASA image by Jeff Schmaltz, MODIS Rapid Response Team, Goddard Space Flight Center.⁴²

2.2.10. ADEQUACY OF WATER-RELATED DATA

The availability of reliable data concerning both the quantity and quality of water is crucial for governments to make informed water policy decisions. For instance, pollution tracking and environmental monitoring are critical activities, given the potential for serious and irreversible damage to human health and the environment from water pollution. The adequacy of such data, however, has long been a problem in most developed countries, and is proving to be an even greater problem in many developing countries.⁴³

The availability and effective utilization of reliable data is a key factor influencing the success of governmental efforts to accurately identify water issues, develop appropriate responses to these issues, and monitor the effectiveness of actions taken in response to the issues. For example, water monitoring data is essential for determining if a water body is contaminated and, if it is, for identifying the types and sources of pollutants responsible for the contamination (see fig. 10). Beyond identifying problems, water-related data can also be used to determine the types and scale of activities needed to accomplish water goals. For instance, detailed and accurate data on anticipated water usage is necessary for determining the appropriate size of infrastructure needed to provide safe drinking water to a community. Finally, governments need post-project monitoring data to accurately gauge the effectiveness of the actions they take to address their critical water issues.

Despite the importance of reliable data, the UN reports there are large gaps in monitoring efforts and in the availability of data related to water quality, especially at the global scale.⁴⁴ Notably, groundwater data are even more limited in scope and availability than surface water data. Even where data on ground or surface water quality do exist, there are often problems that limit their usefulness, such as inconsistencies in the way the data were collected or presented, limitations in the scope of the data, or challenges in making the data accessible to those who could use it.

⁴² This image was obtained from NASA Visible Earth at <http://visibleearth.nasa.gov/>

⁴³ See the INTOSAI WGEA report, *Environmental Data for Auditors: Options and Resources*, for detailed information on how SAIs have used environmental data to conduct audits.

⁴⁴ UNEP and Pacific Institute, *Clearing the Waters: A Focus on Water Quality Solutions*, 2010.

Figure 10: A U.S. Fish and Wildlife Official Collecting Water Quality Data in the State of Vermont



Source: U.S. Fish and Wildlife Service / photo by Hollingsworth

Developing comprehensive water quality monitoring programs is an expensive and resource-intensive task, but many countries and multinational entities have taken steps to expand their collection of water data and to improve the dissemination of data to potential users. For instance, some countries—such as the United States and Canada—have made water quality databases and other water-related data available to the public via the Internet.⁴⁵ At the regional level, the EU Water Framework Directive requires member states to have monitoring programs and to ensure that the programs achieve some standard outcomes, including the kinds of parameters monitored, the methods used for analysis, and the frequency of sampling.⁴⁶ In an effort to improve access to water quality data at a global scale, in 2006 the UN launched an open global online database designed to share surface and groundwater data sets from around the world. Since its launch, the United Nations Global Environment Monitoring System (GEMStat) database has collected more than four million data records related to water quality provided by over 100 countries.⁴⁷

2.2.1.1. IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES

The prospect of climate change introduces additional complications, and a significant element of uncertainty, about most of the water-related challenges discussed above.⁴⁸ The anticipated water-related impacts of climate change are expected to be widespread and significant. In most cases, climate change can be expected to accelerate and amplify already-challenging problems. For example, in its 2007 Fourth Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) identified numerous areas of concern regarding the impacts of climate change on water, including:⁴⁹

⁴⁵ See, for example, the United States Environmental Protection Agency's ATTAINS database, which contains information about the conditions of surface waters, available at <http://www.epa.gov/waters/ir/> (link current as of November 7, 2012).

⁴⁶ UNEP and Pacific Institute, *Clearing the Waters: A Focus on Water Quality Solutions*, 2010.

⁴⁷ For additional information about the GEMStat database or to search for international water quality data, visit <http://www.gemstat.org/> (link current as of November 7, 2012).

⁴⁸ See the INTOSAI WGEA's 2010 report titled, *Auditing the Government Response to Climate Change: Guidance for Supreme Audit Institutions*, for additional information on the role of SAIs in auditing climate change issues.

⁴⁹ M. L. Parry et al., eds., *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge, United Kingdom: Cambridge University Press, 2007).

- **Decreased freshwater availability.** Semi-arid and arid areas (e.g., the Mediterranean basin, western United States, southern Africa, and north-eastern Brazil) are particularly vulnerable to the impacts of climate change on freshwater, primarily due to anticipated changes in precipitation patterns coupled with increasing water demand by growing populations.
- **Increased risks of flooding and drought.** Greater variability in precipitation patterns and higher incidences of extreme weather events are expected to increase both the frequency and severity of flooding and drought in areas prone to these disasters.
- **Sea level rise.** The anticipated rise in global sea levels is forecasted to produce a variety of harmful impacts, including increased coastal flooding risks and greater salinisation of groundwater and estuaries, which will decrease the quality and quantity of freshwater available for humans and ecosystems (see fig. 11).

Figure 11: Increased Glacial Melting Due to Climate Change is Expected to Contribute to Future Sea Level Rise



Source: PhotoDisc

Confronted by these and other water-related threats posed by climate change, more and more nations are beginning to undertake serious adaptation measures to address changes in their water resources. For instance, the IPCC reported that parts of the western United States have increasingly used markets to allocate water between different uses (such as from agricultural to urban or environmental uses), and that water markets have also developed in Chile, Australia, and parts of Canada. Other areas of focus for adaptation efforts around the world include, but are not limited to, using economic incentives to encourage greater water conservation, changing agricultural practices to reduce water demand, and developing desalination plants to produce usable freshwater. Countries facing increased flood risks have generally sought to mitigate these risks by installing physical flood protection measures or by altering land uses and zoning regulations to reduce the potential damage caused by flooding under various climate change scenarios.

3.

AN OVERVIEW OF WATER-RELATED AUDITS AND THE APPROACHES SAIs HAVE USED TO AUDIT WATER ISSUES

INTRODUCTION

This chapter presents an empirical overview of the wide range of audits SAIs have performed to evaluate the actions their governments have taken to address the critical water issues introduced in chapter 2. In recent years, SAIs around the world have performed a growing number of water-related audits of various types, including individual national reviews as well as parallel and cooperative audits conducted in conjunction with other SAIs. This chapter discusses those audits, focusing primarily on reports that have been published since 2004.

The foundation of this chapter is based upon the results of an analysis of 105 recent water-related audits published by SAIs from 43 countries (see fig. 12).⁵⁰ This analysis featured audits from a geographically diverse array of developed and developing countries, and many of the audits were identified for inclusion based on input provided by SAIs. Furthermore, in many cases the information presented on the audits highlighted in this chapter was also supplemented by insights obtained directly from the auditors that performed the evaluations.

⁵⁰ See appendix 2 for a list of all of the audits included in this analysis.

Figure 12: Map of Countries Whose SAI's Reports Are Included in the Audit Analysis



Source: United States Government Accountability Office analysis

3.1. AUDIT MATRICES AS A TOOL FOR PLANNING AND COMMUNICATING AUDIT STRATEGIES

Although information on audit findings and conclusions is also presented below, the primary focus of this chapter is on describing the approaches SAIs have used to audit water-related issues. In particular, to illustrate the range of approaches SAIs have used to conduct water-related audits around the globe, this chapter uses audit matrices to highlight noteworthy audits from each of the 11 water issue areas. Audit matrices—also referred to as “design matrices” by many SAIs—are commonly used as a tool to visually present information on the key elements of an audit plan, including details on the audit’s objectives, methodology and results.⁵¹ While variations exist in the exact format of the matrices used by different SAIs, typically the matrices consist of a table divided into several columns, each of which contains information on a key element of the audit. Generally, information is presented linearly from left to right within the matrices, beginning with a column on audit objectives on the left and ending with a column on audit results on the right, with the center columns providing details on the steps taken by the SAI to address the audit objectives and develop findings.

In most cases, SAIs use audit matrices as a planning tool at the beginning of an investigation to help guide their forthcoming audit activities. However, the audit matrices presented in this chapter serve a different purpose, as they are designed to capture the recent efforts of different SAIs to audit water-related issues by providing information on completed audits. Within each matrix, particular attention is given to discussing the audit’s objectives and criteria, the types and sources of information analyzed in the audit, the methods the SAIs used to address the objectives, any challenges they experienced in doing so, and the key results of the investigation.

The remainder of this chapter is divided into individual subsections for each of the water issue areas introduced in chapter 2. Within each subsection, a brief overview of the types of activities commonly audited by SAIs in the particular issue area is presented first, based upon the results of the analysis of water-related audits. Following the overview of SAI experiences, a detailed audit matrix is presented for one noteworthy audit from each issue area to (1) provide a real-life example of how a particular methodological approach was used to address a key water issue, and (2) illustrate how the audit matrix can be used as a tool to summarize information valuable to SAIs in planning their audits.

⁵¹ Previous WGEA guidance documents have also highlighted the value to SAIs of using audit matrices in their work. See, for example, the 2010 WGEA guidance documents titled, *Auditing Sustainable Fisheries Management: Guidance for Supreme Audit Institutions and Auditing the Government Response to Climate Change: Guidance for Supreme Audit Institutions*.

3.2.

SAIs' EXPERIENCES IN AUDITING A RANGE OF KEY WATER ISSUES

The following subsections discuss SAI audits of various high-profile water-related issues. The range of audits analyzed within each issue area is characterized at a high level based on common themes or shared areas of focus between different SAIs. Within the issue area discussions, recent audit examples are introduced to help illustrate the types of audit activities SAIs have performed, highlighted by a detailed look at one key featured audit from that area. At the conclusion of each subsection, a completed audit matrix is presented for the featured audit from that issue area.

3.2.1.

AVAILABILITY OF SAFE DRINKING WATER

SAIs have devoted considerable attention to their governments' performance in providing safe drinking water to their citizens. Most audits in this issue area can be categorized as focusing on the quality of drinking water in a country or on the availability of adequate drinking water supplies in the country. Some SAIs also examined less common topics related to drinking water. For example, in 2008 the SAI of the Netherlands audited the effectiveness of the Dutch government's international efforts to provide clean drinking water to citizens in developing countries.⁵² Alternatively, the SAI of the United States published an audit in 2003 assessing the safety of drinking water systems against terrorism and the actions being taken by the government to secure these systems.⁵³

Nevertheless, most of the of the drinking water audits included in this analysis examined issues relating to the quality or quantity of drinking water in particular countries. For instance, in 2008 the SAI of Malaysia investigated compliance with drinking water quality standards in 13 states by interviewing officials, analyzing records and documents, visiting water treatment plants, and obtaining feedback on water quality from users through a questionnaire.⁵⁴ The SAI uncovered a number of weaknesses in Malaysia's drinking water quality management, including problems with the testing procedures at water treatment plants and improper cleaning practices for some water infrastructure. In another example, the SAI of Ghana audited the actions taken by Ghana's government and assisted by international aid agencies to expand access to safe drinking water for Ghana's citizens.⁵⁵ Published in 2006, this audit found that, despite some progress having been made, many people still lacked easy access to potable water and some communities continued to suffer from water-related diseases such as guinea worm.

FEATURE AUDIT:

LOCAL AUTHORITIES: PLANNING TO MEET THE FORECAST DEMAND FOR DRINKING WATER, NEW ZEALAND

Figure 13 features a performance audit published in 2010 by the SAI of New Zealand that examined the extent to which New Zealand was prepared to meet the likely future demand for drinking water. This audit followed concerns raised by the media and public that some local authorities may not be well-equipped for this task. Of particular importance, a reliable water demand forecast can help ensure that local authorities supply enough drinking water for future domestic and commercial uses, and that infrastructure investments are appropriately sized to meet a community's actual water needs. The SAI focused this audit on the

performance of eight selected local authorities and produced a report that illustrates, among other things, the benefits of using case studies as a primary audit tool.

Follow-up work performed by the SAI to evaluate the audit's impact found that the audited local authorities had made good progress in addressing the report's recommendations. Also, the SAI discovered that many local authorities that had not been directly involved in the original audit still reported using the SAI's audit framework to subsequently assess their own practices for forecasting drinking water demand.

⁵² Netherlands Court of Audit, *Drinking Water in Developing Countries*, 2008. (Note: this audit report can be obtained from the EUROSAs WGEA [website](#))

⁵³ United States Government Accountability Office, *Drinking Water: Experts' Views on How Future Federal Funding Can Best be Spent to Improve Security*, 2003. (Note: this audit report can be obtained from the SAI's [website](#))

⁵⁴ Malaysia Office of the Auditor-General, *A Study on Management of Drinking Water Quality*, 2008. (Note: a summary of this audit report can be obtained from the WGEA [website](#))

⁵⁵ Ghana Audit Service, *Performance Audit Report of the Auditor-General on the Provision of Safe Drinking Water*, 2006. (Note: this audit report can be obtained from the SAI's [website](#))

**FIGURE 13: AUDIT MATRIX FOR THE SAI OF NEW ZEALAND'S
"LOCAL AUTHORITIES: PLANNING TO MEET THE FORECAST DEMAND FOR DRINKING WATER" REPORT^a**

Objectives / Researchable Question(s)	Audit Criteria, Key Information Required, Source(s) of Information	Scope and Methodology	Challenges Encountered in Conducting the Audit	Audit Results and Key Findings
<p>The aim of this audit was to provide the New Zealand Parliament with assurances about whether local authorities were managing their drinking water supplies effectively enough to meet the likely future demand for drinking water.</p> <p>Specifically, the Office of the Auditor-General (OAG) examined whether local authorities:</p> <ul style="list-style-type: none"> • had good quality data—and used this data through reliable techniques—to effectively forecast what the future demand for drinking water might be; • had effective supply and demand management strategies for meeting the forecast demand for drinking water; and • were managing their drinking water supply systems (e.g. building, maintaining and upgrading infrastructure) to be able to effectively and efficiently supply water. 	<p>Criteria</p> <p>The OAG derived criteria for this audit from the following main sources:</p> <ul style="list-style-type: none"> • Legislation – including (1) <i>Health (Drinking Water) Amendment Act 2007</i>; (2) <i>Local Government Act 2002</i>; and (3) <i>Resource Management Act 1991</i>. • Drinking water regulations and standards • Asset management criteria established in the <i>International Infrastructure Management Manual (2006)</i> <p>Required Information and Its Sources</p> <ul style="list-style-type: none"> • Information on approaches used to manage drinking water and forecast future demand, obtained from documentation (e.g., asset management plans) and interviews with officials at the audited local authorities. • Information on the challenges facing water supply systems, obtained through site visits to water treatment facilities and interviews with engineers and local and regional officials. 	<p>The OAG utilized a case study approach to conduct this audit, examining and comparing the activities and performance of eight local authorities in the area of drinking water management and forecasting. These local authorities represent approximately 10 percent of the local governments in New Zealand, and consisted of a diverse sample of locations differing in size, geography, revenues, and weather, among other factors. To evaluate these local authorities, the OAG:</p> <ul style="list-style-type: none"> • Analyzed documentation, such as local planning documents and asset management plans; • Interviewed officials from the local authorities and regional council members; • Obtained advice from an external expert on drinking water supply management; and • Conducted site visits to all eight local authorities, including visits to water treatment plants and <i>interviews</i> with engineers working at these facilities. Of particular importance, the site visits helped the audit team develop a better understanding of the unique circumstances and complexities confronting each of the local authorities in their efforts to manage drinking water supplies and forecast future demand. 	<p>The OAG reported that this audit took place at the same time as when the local authorities were updating their mandated long-term planning documents. As a result, the local authorities were busy fulfilling these responsibilities and had reduced availability to work with the OAG. Consequently, the OAG decided to delay the audit to enable the most up-to-date information from local authorities' long-term plans to be used.</p> <p>Additionally, the OAG noted that assembling an audit team with expert knowledge of both water management and local government was a challenge. Likewise, the logistics of planning, coordinating and developing findings and conclusions from eight local authority site visits also proved to be challenging.</p>	<p>OAG's analysis revealed variable performance amongst the local authorities and found that some faced more challenges than others in supplying high quality drinking water and forecasting demand. However, the OAG was encouraged that each local authority acknowledged its challenges and was actively working on solutions.</p> <p>Specifically, the OAG reported that, of the eight local authorities it examined:</p> <ul style="list-style-type: none"> • three were effectively managing their drinking water supplies and were well prepared to meet the forecast demand for drinking water; • three were adequately managing supplies and were adequately prepared to meet future demand; and • two were poorly managing supplies and were poorly placed to meet future demand, having a significant amount of work to do to improve forecasts and upgrade drinking water infrastructure. <p>According to a member of the audit team, visiting water treatment plants and interviewing engineers were particularly valuable methods for developing the audit findings. In particular, the OAG found that local authorities could improve by:</p> <ul style="list-style-type: none"> • improving the information available for demand forecasting; • using more tools to assess and verify the reliability of demand forecasting; • preparing comprehensive demand management plans; and • putting more emphasis on improving the efficiency of drinking water supply systems.

^a This audit report is available at <http://www.oag.govt.nz/2010/water/docs/oag-water.pdf>

3.2.2.

COMPETING DEMANDS FOR LIMITED WATER SUPPLIES

SAIs have taken notice of the challenges associated with balancing competing demands for limited water supplies between important uses and are increasingly beginning to look at the actions their governments are taking in response to them. For example, in 2011 the SAI of Australia released an audit report on its government's efforts to acquire and allocate water resources for the benefit of the natural environment in the Murray-Darling Basin, an area of national environmental, economic and social significance.⁵⁶ Water supplies in the basin decreased in the years prior to the audit, primarily due to drought conditions and competing demands for the available water resources between supplying drinking water for humans, providing water for agricultural and industrial needs, and various ecological concerns. Overall, the SAI found that the Australian government had generally done a good job of implementing its program to purchase additional water resources for the purpose of supporting environmental priorities in the Murray-Darling Basin.

Energy production and the demands it can place on water resources is another area that some SAIs have focused on when examining the pressures facing their countries' limited water supplies. For example, the SAI of the United States has published a series of audit reports in recent years investigating the nexus between different types of energy development and water usage. Among the topics covered by these reports was oil shale development in the western United States, a subject matter explored in-depth in the feature audit highlighted below.

FEATURE AUDIT:

ENERGY-WATER NEXUS: A BETTER AND COORDINATED UNDERSTANDING OF WATER RESOURCES COULD HELP MITIGATE THE IMPACTS OF POTENTIAL OIL SHALE DEVELOPMENT, UNITED STATES OF AMERICA

Developing oil shale resources in the western United States could help to satisfy the United States' future oil demands. However, oil shale operations will require large amounts of water, and some analysts predict that diverting water for oil shale development would restrict agricultural and urban development in the region. In light of these issues and the potential economic benefits associated with developing these resources, the SAI of the United States conducted an audit examining the potential

impacts of oil shale development on water supplies. Following the report's publication in 2010, the SAI was invited to testify before a Congressional committee about the results of the audit, and the report's impact was also evident in the coverage it received from various local media sources and environmental publications. Figure 14 presents additional information about this report, its results, and the methods used to conduct the audit.

⁵⁶ Australian National Audit Office, *Restoring the Balance in the Murray-Darling Basin*, 2011. (Note: this audit report can be obtained from the SAI's [website](#))

FIGURE 14: AUDIT MATRIX FOR THE SAI OF THE UNITED STATES’ “ENERGY-WATER NEXUS: A BETTER AND COORDINATED UNDERSTANDING OF WATER RESOURCES COULD HELP MITIGATE THE IMPACTS OF POTENTIAL OIL SHALE DEVELOPMENT” REPORT^a

Objectives / Researchable Question(s)	Audit Criteria, Key Information Required, Source(s) of Information	Scope and Methodology	Challenges Encountered in Conducting the Audit	Audit Results and Key Findings
<p>To perform this audit, the Government Accountability Office (GAO) examined:</p> <ol style="list-style-type: none"> 1) what was known about the potential impacts of oil shale development on surface water and groundwater; 2) what was known about the amount of water that may be needed for commercial oil shale development; 3) the extent to which water will likely be available for commercial oil shale development and its source; and 4) federal research efforts to address impacts to water resources from commercial oil shale development. 	<p>Criteria</p> <ul style="list-style-type: none"> • Law – <i>Energy Policy Act of 2005</i> • Regulations proposed by the Department of the Interior on oil shale development • Departmental mission statements <p>Required Information and Its Sources</p> <ul style="list-style-type: none"> • Information on potential water-related impacts of oil shale development, obtained from: <ul style="list-style-type: none"> - studies published by public and private research entities; - agency documents; and - interviews with federal and state officials, as well as representatives of the oil industry and environmental groups. • Information on the amount of water needed for oil shale development and the likely availability of water for this purpose, obtained from: <ul style="list-style-type: none"> - Studies on oil shale development and interviews with the authors; and - Water estimates and projections produced by federal and state agencies. • Information on federal research efforts, obtained from a review of documentation and interviews with officials from federal and state agencies, universities, the oil industry, and water experts. 	<p>This audit examined the state of knowledge and activities related to potential oil shale development in the states of Colorado and Utah, as these are the areas in which the oil industry is most interested in developing oil shale deposits. To perform this evaluation, GAO:</p> <ul style="list-style-type: none"> • Analyzed studies on the water requirements of oil shale development. This analysis was limited to studies published in 1980 or later, and included studies prepared by federal agencies, academics, and private research entities. • Reviewed agency documentation, such as the environmental impact statement on oil shale development prepared by the Bureau of Land Management. • Interviewed a variety of stakeholders involved in oil shale development or research, including officials from federal and state agencies, industry representatives, environmental group representatives, authors of the studies identified in the literature review, and academics. In addition, the audit team interviewed water experts and other specialists (e.g., geologists) to obtain their expert opinions and to validate the accuracy of the different studies and data GAO was analyzing. • Conducted site visits to oil shale demonstration projects. 	<p>A senior member of the audit team reported that it was challenging for GAO to develop estimates of the amount of water required for commercial oil shale production due to:</p> <ul style="list-style-type: none"> • resistance from oil industry members to sharing proprietary data on oil shale technologies; and • general uncertainty about the unproven technologies themselves. <p>As a result of these limitations, the audit’s data on the water needs of oil shale development were presented as a range of potential values rather than a specific numerical estimate.</p>	<p>Although oil shale development could have significant impacts on the quality and quantity of water resources, this audit was unable to determine the magnitude of these impacts due to the unproven nature of oil shale technologies and the lack of reliable information on the status of water resources in the region.</p> <p>Nevertheless, GAO attempted to quantify the expected total water needs for oil shale production by providing a range of potential estimates based on its analysis of research studies and limited assistance provided by external experts. Using this data and information obtained from interviews with government officials and other stakeholders, the audit team found that the size of the oil shale industry in Colorado and Utah could eventually be limited by water availability issues.</p> <p>In addition, GAO reported that its interviews with officials and water experts revealed there were insufficient data to understand the baseline conditions for water resources in the oil shale regions of Colorado and Utah. Furthermore, this problem is exacerbated by the lack of coordination between the federal and state agencies that conduct water-related oil shale research and those that regulate water.</p>

^a This audit report is available at <http://www.gao.gov/assets/320/311896.pdf>

3.2.3. DROUGHT

Drought is one of the most significant water challenges facing some countries, but its prominence varies considerably based on geography. Consequently, the extent to which governments have been required to take action to address drought-related issues differs between nations and has influenced the amount of attention paid to the topic by different SAIs. In countries that frequently experience droughts—such as Cyprus and Australia—the resulting widespread impacts and damage drought causes have been matters of significant importance for their SAIs.

For example, in 2008 the SAI of Cyprus released a report on its investigation into the reasons behind the severe water shortage Cyprus experienced in 2007 and 2008 amidst an ongoing drought.⁵⁷ As a result of this drought, Cyprus imposed restrictions on the supply of water to households and farmers and was forced to purchase and import large quantities of water from Greece. The SAI determined that the main reasons for these drastic responses to the country’s water shortages were the lack of adherence to water allocation guidelines and delays in the construction of a pending desalination plant. Furthermore, in this audit the SAI identified several actions that could be taken to reduce future water use and more effectively prioritize water deliveries, such as eliminating the production of agricultural goods that require disproportionately large quantities of water to produce.

FEATURE AUDIT: DROUGHT ASSISTANCE, AUSTRALIA

Drought has historically been a recurring feature of Australia’s climate and poses a considerable threat to the productivity of the nation’s agricultural sector and the viability of some rural farming communities. In response, the SAI of Australia has conducted numerous audits focused on the impacts drought has on the country’s residents, economy, and environment, as well as looking at the government’s efforts to mitigate drought’s consequences. For example, figure 15 presents information on a recent drought-related audit published by the SAI of Australia amidst the government’s ongoing comprehensive review of

Australia’s drought policy. Within this context, the SAI conducted an audit of the Australian Department of Agriculture, Fisheries and Forestry’s administration of drought-related financial assistance measures for farmers and small businesses, and examined the implementation of a pilot program of new drought reform measures that were being tested in Western Australia. Published in 2011, this audit report helps to illustrate how SAIs from developed countries often rely on combinations of basic audit tools (such as document analyses, interviews, and site visits) to produce compelling audit results.

⁵⁷ Audit Office of the Republic of Cyprus, *Water Management: The Serious Reduction of Water Reserves in Cyprus*, 2008. (Note: this audit report can be obtained from the WGEA [website](#))

FIGURE 15: AUDIT MATRIX FOR THE SAI OF AUSTRALIA'S "DROUGHT ASSISTANCE" REPORT^a

Objectives / Researchable Question(s)	Audit Criteria, Key Information Required, Source(s) of Information	Scope and Methodology	Challenges Encountered in Conducting the Audit	Audit Results and Key Findings
<p>To assess the effectiveness of the Department of Agriculture, Fisheries and Forestry's (DAFF's) administration of drought assistance measures and the implementation of the pilot program of new drought reform measures, the Australian National Audit Office (ANAO) examined DAFF's:</p> <ul style="list-style-type: none"> • processes for approving and reviewing drought declarations for states and territories. Approved declarations were needed for residents to be eligible for assistance; • arrangements for the delivery of drought assistance by national, state and territory governments; • monitoring and reporting on performance; and • management of the pilot program for new drought reform measures. 	<p>Criteria</p> <ul style="list-style-type: none"> • Law – <i>Rural Adjustment Act 1992</i> • Legal agreements between the national government and state and territory governments, and between DAFF and other entities to deliver drought assistance programs. • The National Partnership Agreement. • Program guidance documents and information handbooks <p>Required Information and Its Sources</p> <ul style="list-style-type: none"> • Documentation and data on drought assistance programs and payments. • Documentation on drought declaration applications and associated decision making processes. • Documentation underpinning the drought reform measures pilot program. • Previous reviews of drought assistance measures performed by the ANAO and other entities. • Perspectives of recipients, industry stakeholder groups, and officials from national, state, and territory government agencies obtained through interviews and site visits. 	<p>To evaluate DAFF's performance in administering drought assistance measures, the ANAO focused its analysis on actions taken in an indicative sample of 28 (out of a total of 92) geographic areas that had applied for a new drought declaration or had an existing declaration in place between July 2007 and June 2010. To perform this analysis and evaluate the management of the pilot program, the audit team:</p> <ul style="list-style-type: none"> • Examined files, documentation, and data related to drought declarations and the delivery of financial assistance to recipients in the sample areas. • Interviewed officials from national, state, and territory government agencies, as well as key stakeholder groups including representatives of farming industry organizations, and rural financial counselors. The audit team estimated that it conducted 25 formal interviews during this audit. • Conducted site visits to observe the impact that the drought and the Government's assistance measures were having on the affected areas and their inhabitants. In particular, the audit team visited four areas with existing drought declarations, as well as Western Australia to observe the pilot program activities. During the site visits, the audit team collected photographic evidence and interviewed farmers and small business operators to obtain their perspectives on the drought and the value of the assistance measures. 	<p>According to the ANAO, the extended period of drought across Australia and access to assistance premised on a drought declaration created a challenging environment in which to conduct the audit. As fieldwork was conducted in the pilot program region and across areas where the need for a drought declaration was being assessed, the auditors reported the need to manage external expectations by carefully explaining the ANAO's role and mandate.</p>	<p>The results of the audit work performed by the ANAO revealed that DAFF's administration of the drought assistance programs and the pilot of new drought measures had generally been sound. However, the audit also identified some elements of DAFF's oversight of drought assistance efforts that could be improved, including:</p> <ul style="list-style-type: none"> • DAFF's monitoring of the performance of its partner entities involved in delivering drought assistance payments to recipients; and • DAFF's performance measures for drought programs, which captured outputs (such as the number of payments) rather than the impact or outcome of the assistance programs. The audit identified a gap in performance information about drought assistance programs, and reported that establishing outcome-oriented indicators would provide better information to decisionmakers. <p>The audit team considered that observations during site visits and interviews helped them understand the drought's impact and the role of the assistance measures in mitigating its damage. The information gathered through this approach was supplemented with additional evidence obtained through the analysis of program documentation and data, and interviews with government officials and other stakeholders.</p>

^aThis audit report is available at <http://www.anao.gov.au/-/media/Uploads/Audit%20Reports/2010%2011/201011%20Audit%20Report%20No%2053.pdf>

3.2.4. FLOODING

Given the enormous consequences associated with massive flooding, many governments have devoted considerable resources to implementing measures designed to prevent floods from occurring and to protect homes and businesses at risk of flooding. Not surprisingly, these efforts have also drawn the attention of many SAIs, which have focused in particular on the status and performance of flood prevention and protection measures. For example, the SAI of the Slovak Republic published an audit in 2011 that examined its government's response to severe floods in 2010 and assessed the effectiveness and efficiency of the government's use of funds for flood prevention and protection measures.⁵⁸ Amongst other findings presented in this audit, the SAI identified deficiencies in the performance of the government's flood commission and reported that flood prevention activities had not received sufficient funding.

Although many flood events occur exclusively within the borders of individual countries, in some instances flooding has crossed national boundaries and impacted multiple countries at the same time. This situation can occur when rivers span multiple nations or serve as a border between neighboring countries, and many countries in this position have coordinated with their neighbors in responding to their shared flooding threat. In a similar fashion, some SAIs have worked together to audit their governments' efforts to address transboundary flooding issues. For example, from 2005 to 2007, the SAI of Ukraine completed three parallel audits with the SAIs from Hungary, Poland, and the Slovak Republic that focused, at least in part, on Ukraine's efforts to coordinate its flood control activities with each of these neighboring states.⁵⁹

FEATURE AUDIT:

A PERFORMANCE AUDIT OF THE MANAGEMENT OF PREVENTION AND MITIGATION OF FLOODS AT CENTRAL, REGIONAL AND LOCAL LEVELS OF THE GOVERNMENT OF TANZANIA: A CASE STUDY OF FLOODS IN BABATI, TANZANIA

Figure 16 presents an example of a flood-related audit published by the SAI of Tanzania in 2007. In this audit, the SAI evaluated the performance of public authorities at the national, regional, and local levels in carrying out their flood prevention and mitigation responsibilities in Babati, an area that had experienced many floods in recent decades. Although the findings and recommendations identified in this audit were developed based on the situation in Babati, the SAI reported that the audit results were also believed to be applicable to other disaster-prone areas of the country. According to a member of the audit

team, this audit received considerable media coverage in Tanzania and prompted a visit by Parliamentarians to Babati to assess the situation in person. Furthermore, the audited authorities have subsequently implemented some of the recommendations presented in the audit, including improving the capacity of bridges and drainage culverts to safely handle larger water flows. Amongst the noteworthy methodological aspects of this report, this audit stands out for its widespread use of photographic evidence to develop and support key findings.

⁵⁸ Supreme Audit Office of the Slovak Republic, *Governance of Public Funds Allocated for Flood Protection and Elimination of the Consequences*, 2011.

⁵⁹ Accounting Chamber of Ukraine and the State Audit Office of Hungary, *Audit of the Flood Control Preparedness in the Upper Tisza Region*, 2005. (Note: this audit report can be obtained from the WGEA [website](#))

Accounting Chamber of Ukraine and the Supreme Chamber of Control of Republic of Poland, *Joint Report on Auditing Implementation of Flood Protection Measures on Transboundary Waters of Ukraine and Republic of Poland*, 2006. (Note: this audit report can be obtained from the EUROSAI WGEA [website](#))

Accounting Chamber of Ukraine and the Supreme Audit Office of the Slovak Republic, *Joint Report on the Results of the Parallel Audit of Implementation of the Agreement on Transboundary Water Issues Signed by the Government of the Slovak Republic and the Government of Ukraine*, 2007. (Note: this audit report can be obtained from the EUROSAI WGEA [website](#))

FIGURE 16: AUDIT MATRIX FOR THE SAI OF TANZANIA'S "FLOODS IN BABATI" REPORT^a

Objectives / Researchable Question(s)	Audit Criteria, Key Information Required, Source(s) of Information	Scope and Methodology	Challenges Encountered in Conducting the Audit	Audit Results and Key Findings
<p>The general purpose of this audit was to assess how Tanzania's central, regional, and district government authorities managed flood disasters and whether they had taken the steps necessary to prevent future floods. Specific audit questions included:</p> <ol style="list-style-type: none"> 1) Were adequate preventive structures in place for floods? 2) Was there an appropriate drainage system in place for flood water? 3) Were residences located in areas threatened by flooding? If so, what measures had been taken to reduce flood damages? 4) Had the Regional Secretariat developed an anti-flood program and mobilized funds for flood prevention? 5) Had the Disaster Management Department established an adequate monitoring system for flood prevention in Babati and elsewhere? 6) Had the Disaster Management Department arranged events to help improve flood management in Babati? 	<p>Criteria</p> <ul style="list-style-type: none"> • Law - <i>Disaster Relief Coordination Act No. 9 of 1990</i> • Policy - <i>The National Disaster Management Policy of May 2004</i> • Guidelines - <i>The National Operational Guidelines of 2003 for Disaster Management</i> <p>Required Information and Its Sources</p> <ul style="list-style-type: none"> • National laws and policy documents • Documentation maintained by the audited entities on disaster management responsibilities and how they had been implemented in Babati. • Information on flood prevention activities in Babati and the roles of different government entities in managing flood events, obtained through interviews with officials at the national, regional, and district levels. • Perspectives of local citizens and officials from non-governmental organizations obtained through interviews and focus groups. • Photographic evidence of flood prevention infrastructure obtained during site visits. 	<p>This audit used a case study approach to assess Tanzania's disaster management processes and its ability to respond to disasters. Specifically, this audit focused on the prevention and mitigation of floods, and provided an in-depth examination of the flood-related disaster management experiences in one location—Babati District. Rather than examine multiple areas, the SAI focused its limited resources on conducting a thorough evaluation of the situation in Babati and determining if there were any findings or shortcomings in that case that would be applicable to other locations as well.</p> <p>In particular, the SAI focused its review on the actions of five entities responsible for disaster management, including a mix of national, regional, and district authorities.</p> <p>To audit these entities, the SAI:</p> <ul style="list-style-type: none"> • Reviewed documentation from the audited entities to understand how they implemented their disaster management and prevention roles and responsibilities. • Interviewed officials from the audited entities at the national, regional, and district levels, including directors, planning officers, and engineers, among others. • Held focus group discussions with experts knowledgeable about floods and other disasters (such as officials from non-governmental organizations), as well as local citizens in Babati to obtain a diverse array of views and perspectives. • Conducted site visits to directly observe and take photographs of the flood prevention infrastructure in Babati. The audit team compared the photographs it took against pictures taken during the most recent flood event to assess the status of the flood prevention infrastructure. 	<p>One general challenge associated with using a case study approach is that it can be difficult to generalize the results of the audit to a broader set of circumstances. To address this challenge, the SAI shared its findings with the Disaster Management Department to determine if the situation in Babati was similar to the situation in other areas as well. According to a member of the audit team, the Disaster Management Department confirmed that the findings and shortcomings identified by the audit were also applicable to other areas of the country subject to disasters.</p> <p>In addition, another challenge reported by the SAI was that the Disaster Management Department only had limited information about previous floods in Babati and the current status of flood prevention efforts in the audit area.</p>	<p>The results of this case study audit revealed that public authorities at the national, regional, and local levels had collectively failed to take the actions necessary to prepare for, prevent, and mitigate the risks posed by floods in Babati.</p> <p>Despite having experienced many damaging floods in the past, the audit found that the authorities responsible for disaster management continued to operate on a reactive basis and had not installed and maintained adequate flood prevention infrastructure. Although all of the different methods used in the audit contributed to these findings, the physical observations made during site visits and photographic evidence captured by the audit team proved to be essential for assessing the status of the flood prevention infrastructure.</p> <p>Given that the needed preventive actions would not require significant investment to implement, the audit concluded that this inaction could not be attributed to a lack of resources. Rather, the SAI reported that the lack of action to address the flood risks in Babati represented negligence on behalf of the responsible authorities at all levels of government.</p> <p>As a result of these shortcomings, the audit concluded that the risk for future floods to cause further damage in Babati remained very high.</p>

^a This report is available at http://www.environmental-auditing.org/PORTALS/0/AUDITFILES/FULL_FLOOD_REPORT_TANZANIA.PDF

3.2.5. QUALITY OF RIVERS, LAKES, AND OTHER SURFACE WATERS

The quality of surface waters was another often evaluated topic by SAIs. In general, the scope of most audits looking at the quality of surface waters fell into one of two categories. First, some SAIs performed in-depth analyses of water quality issues in specific water bodies, such as high-profile rivers or lakes. For example, in 2008 the SAI of Albania published an audit examining efforts to protect Lake Ohrid and prevent pollution of the lake and its watershed.⁶⁰ This audit analyzed the results of a project funded by the World Bank to help conserve Lake Ohrid, looking particularly at efforts to improve monitoring capabilities, increase public awareness and involvement, and to build institutions for joint management of the lake between Albania and Macedonia. Overall, the SAI reported that the World Bank project had made little impact on the situation in Lake Ohrid and that additional actions were necessary in order to prevent further pollution to the lake and its watershed.

Second, some SAIs looked more broadly at the issue of water pollution, examining the extent of the problem nationwide or assessing particular types or sources of water pollution in depth. For example, in 2008 the SAI of Finland released an audit report on its investigation of efforts to address water pollution caused by nutrient discharges associated with agriculture.⁶¹ In this audit, the SAI sought to determine if the nutrient reduction goals established by Finland's government could be feasibly achieved under existing policies and practices. The SAI concluded that the objective of reducing nutrient emissions was at odds with other objectives that had been set in agricultural policy and, barring any changes, the existing means were inadequate to achieve the nutrient emissions target set by the government.

FEATURE AUDIT: TACKLING DIFFUSE WATER POLLUTION IN ENGLAND, UNITED KINGDOM

Responsibility for managing and monitoring water quality in England falls on the Environment Agency, and in 2009 the SAI of the United Kingdom began an examination of the Environment Agency's progress in tackling diffuse pollution. Diffuse pollution—i.e., pollution coming from multiple dispersed sources, such as agricultural land or road runoff—is believed to be a significant cause of pollution in England's water bodies, however the full extent to which it is responsible for the failure to meet water quality standards is unknown. In 2009, only 26 percent of water bodies in England met the water quality requirements established in the European Water Framework Directive.

Furthermore, the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency do not expect that all English water bodies will reach the required quality levels by the mandated date of 2027. Published in 2010, this audit report primarily focused on the Environment Agency's efforts to understand and address pollution resulting from agricultural activity, which is considered to be the greatest source of diffuse pollution in the country. Figure 17 presents additional information about this report, its results, and the diverse array of basic and specialized audit tools the SAI used to conduct this investigation.

⁶⁰ State Supreme Audit of Albania, Report on the Audit Conducted at Ministry of Environment, Forestry, and Water Administration, on the Preservation of Ohrid Lake Project, 2008. (Note: this audit report can be obtained from the WGEA [website](#))

⁶¹ National Audit Office of Finland, Reducing Nutrient Emissions from Agriculture, 2008. (Note: a summary of this audit report can be obtained from the WGEA [website](#))

FIGURE 17: AUDIT MATRIX FOR THE SAI OF THE UNITED KINGDOM'S "TACKLING DIFFUSE WATER POLLUTION IN ENGLAND" REPORT^a

Objectives / Researchable Question(s)	Audit Criteria, Key Information Required, Source(s) of Information	Scope and Methodology	Challenges Encountered in Conducting the Audit	Audit Results and Key Findings
<p>To evaluate the Environment Agency's efforts to address diffuse pollution, the National Audit Office (NAO) assessed whether the Environment Agency:</p> <ol style="list-style-type: none"> 1) Had a good understanding of the sources of diffuse pollution and the reasons why the water quality standards were not being met; 2) Was raising awareness amongst polluters of the diffuse pollution problem and of how changes in their behavior and practices could help to address it; and 3) Was effectively using incentives and sanctions to change the behavior and practices of farmers. 	<p>Criteria</p> <p>The Environment Agency is responsible for adhering to policies on diffuse pollution established in:</p> <ul style="list-style-type: none"> • International agreements, including the: <ul style="list-style-type: none"> - European Water Framework Directive - European Nitrates Directive • National laws, such as the Water Resources Act 1991 • Regulations established by the Department for Environment, Food and Rural Affairs (DEFRA) <p>Required Information and Its Sources</p> <ul style="list-style-type: none"> • Perspectives of farmers obtained through a telephone survey • Information from Environment Agency officials on diffuse pollution efforts, obtained through interviews and electronic surveys. • Perspectives of national and local stakeholders, obtained through interviews and site visits. • Documentation and data maintained by the Environment Agency, DEFRA, and other entities. • Information on actions taken by other countries to address diffuse pollution, obtained with the assistance of an external consultant. 	<p>This audit used a wide variety of methods to examine the Environment Agency's understanding of diffuse pollution in England and the effectiveness of its actions to address the sources of this pollution. The scope of this audit focused on agricultural sources of diffuse pollution. To conduct this audit, the NAO:</p> <ul style="list-style-type: none"> • Worked with a consultant to conduct a telephone survey of farmers on their awareness of diffuse pollution issues and engagement with the Environment Agency. • Electronically surveyed officials at the Agency's headquarters and regional offices on the Agency's efforts at the local level and the extent to which they had changed the behaviors of key polluter groups. • Conducted semi-structured interviews with officials from the Environment Agency and 11 key stakeholder organizations, including conservation bodies and farming organizations, to assess the effectiveness of the Agency's programs and its collaboration with stakeholders. • Used case studies to assess the Agency's efforts at eight sites and to understand how national policy was being delivered at the local level. The case studies involved site visits as well as interviews with Agency staff and local stakeholders. • Reviewed documentation—such as project plans and prior research on diffuse pollution—and analyzed quantitative data—such as water quality data and regulatory enforcement data—provided by the Agency, DEFRA, and other third parties. • Worked with a consultant to conduct an international benchmarking exercise to compare the Agency's work with the diffuse pollution efforts in eight other countries. 	<p>The NAO reported that the original scope of its work included efforts to tackle urban sources of diffuse pollution. However, the majority of the Environment Agency's efforts and knowledge relate to tackling diffuse pollution from the agricultural sector, which it considers to be the major contributor to diffuse pollution. As a result, the Agency's knowledge of other sources of pollution, particularly from urban sources, is less developed. For this reason, the audit focused primarily on agricultural pollution.</p> <p>The NAO also found that the Environment Agency's access to information held by DEFRA on farmers was limited. As a result, the NAO instead worked with a contractor to independently collect information from the agricultural community through a telephone survey to determine the effectiveness of the Agency's work and gauge farmers' knowledge of diffuse pollution.</p>	<p>The NAO concluded that the Environment Agency's efforts had made little impact on reducing diffuse pollution or in mitigating the environmental impacts and financial costs of poor water quality in England. As a result, the NAO reported that the Environment Agency had failed to prove value for the money it had spent in this area. The NAO drew in particular on its telephone survey of farmers, the electronic survey of officials, and the case studies when reaching its judgment and developing the audit findings.</p> <p>Additional key audit findings include:</p> <ul style="list-style-type: none"> • The Environment Agency lacked sufficient information on the causes of diffuse pollution to target its resources effectively. • Despite the Environment Agency's efforts to work with the agricultural community on diffuse pollution issues, farmers' awareness of the problem remained low. • Without the widespread commitment of farmers to tackling diffuse pollution or sufficient access to financial incentives, the impact of voluntary initiatives intended to change farmer behavior and improve water quality had been piecemeal. • The Environment Agency did not have single integrated system to record its inspection activities, which, in addition to the data being incomplete, made it difficult for the Agency to determine the effectiveness of its inspections or the optimal level of inspection activities.

^a This audit report is available at http://www.nao.org.uk/publications/1011/water_quality.aspx

3.2.6. MARINE ENVIRONMENT

For countries located adjacent to an ocean or sea, marine issues were among the most frequently audited water topics examined by their SAIs. The marine environment audits included in this analysis commonly focused on the management of fish resources or on the impacts of pollution in the marine environment, and included audits that were performed independently by SAIs as well as some performed in collaboration between SAIs.⁶² For instance, in 2008 the SAI of China examined the issue of water pollution in the Bohai Sea by independently auditing the pollution control and prevention activities of 13 coastal cities and various state and national departments.⁶³ The SAI's investigation revealed that, among other things, sewage treatment capacity was inadequate, numerous enterprises were exceeding their pollutant discharge quotas, and that the overall plan to control the development and utilization of areas around the Bohai Sea was inadequate.

In addition to audits performed independently by SAIs, this issue area also featured many examples of SAIs working together to address shared challenges in the marine environment. Collaboration between SAIs was particularly evident in audits looking at fisheries and the management of fish resources located in oceans and seas shared by multiple nations. For example, from 2006-2007 the SAIs of Norway and Russia conducted a parallel audit investigating the management and control of fish resources in the Barents Sea and the Norwegian Sea.⁶⁴ Stemming primarily from concerns about illegal overfishing, the SAIs used common audit questions and criteria for their investigations, as well as the same outline for their independent final reports. The SAIs of Norway and Russia continued their collaboration on this topic in 2011, when they conducted a follow-up to the original audit and worked together to perform some audit activities, such as jointly conducting interviews and site visits.⁶⁵

Likewise, some SAIs worked together to audit pollution issues in the marine environment—such as oil spills from ships—that can impact multiple countries at once. For example, in 2004 the SAIs of Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, and Russia conducted a parallel audit analyzing each country's preparedness to combat pollution from ships in the Baltic Sea. In particular, the SAIs assessed their respective country's compliance with applicable articles from the Helsinki Convention concerning pollution from ships. Using the same audit objectives and similar audit criteria and methods, each SAI prepared individual national audit reports and then worked together to produce a joint final report in 2005.⁶⁶

FEATURE AUDIT: THE ENVIRONMENTAL IMPACTS ASSESSMENT OF THE RED TIDE PHENOMENON, KUWAIT

Figure 18 presents an example of an SAI independently auditing issues related to pollution that was created on land—such as sewage and other wastes—and then disposed of in the marine environment. Recent history has shown that Kuwait's coastal waters are vulnerable to the environmental phenomenon commonly referred to as "Red Tide", which develops when an abnormally high concentration of algae causes the water to appear discolored or murky. The disposal of waste, sewage, and other pollutants into the sea is a key contributor to this phenomenon, which is also often harmful to fish,

birds, and other marine animals. In response to this threat, the SAI of Kuwait released an audit report in 2010 assessing the efforts of Kuwait's Environment Public Authority and other cooperative entities to prevent the causes of Red Tide by monitoring the discharge of sewage and other wastes and securing public compliance with water quality regulations. Notably, this audit uncovered several shortcomings in the government's performance on these matters primarily by analyzing water quality samples, interviewing officials, and reviewing official documentation.

⁶² In 2010, INTOSAI's WGEA published a document titled, *Auditing Sustainable Fisheries Management: Guidance for Supreme Audit Institutions*, to help SAIs conduct audits on the sustainable management of fisheries.

⁶³ National Audit Office of the People's Republic of China, *Audit Investigation of Water Pollution Control and Prevention of the Bohai Sea*, 2008. (Note: a summary of this audit report can be obtained from the SAI's [website](#))

⁶⁴ Office of the Auditor General of Norway, *The Office of the Auditor General's Investigation of the Management and Control of Fish Resources in the Barents Sea and the Norwegian Sea – A Parallel Audit Conducted by the Office of the Auditor General of Norway and the Accounts Chamber of the Russian Federation*, 2007. (Note: this audit report can be obtained from the SAI's [website](#))

⁶⁵ Office of the Auditor General of Norway, *The Office of the Auditor General's Follow-up of the Parallel Audit with the Accounts Chamber of the Russian Federation of the Management of the Fish Resources in the Barents Sea and the Norwegian Sea*, 2011. (Note: a summary of this audit report can be obtained from the SAI's [website](#))

⁶⁶ National Audit Office of Denmark, et al., *Joint Final Report on Audit of Implementation of Provisions of the Convention on the Protection of the Marine Environment of the Baltic Sea Area (The Helsinki Convention): Pollution from Ships in the Baltic Sea*, 2005. (Note: this audit report can be obtained from the WGEA [website](#))

FIGURE 18: AUDIT MATRIX FOR THE SAI OF KUWAIT’S “THE ENVIRONMENTAL IMPACTS ASSESSMENT OF THE RED TIDE PHENOMENON” REPORT^a

Objectives / Researchable Question(s)	Audit Criteria, Key Information Required, Source(s) of Information	Scope and Methodology	Challenges Encountered in Conducting the Audit	Audit Results and Key Findings
<p>The State Audit Bureau of Kuwait (SAB) focused on the following general objectives in its evaluation of Kuwait’s efforts to address and prevent the Red Tide phenomenon:</p> <ul style="list-style-type: none"> • To assess the extent to which the disposal of sewage and other wastes in the sea is performed in compliance with standards and regulations established by the Environment Public Authority (EPA). • To evaluate the effectiveness of the systems and equipment used to monitor sewage and other wastes discharged into the sea. • To assess the overall performance and capacity of the entities responsible for controlling the causes of Red Tide. 	<p>Criteria</p> <ul style="list-style-type: none"> • Environmental protection laws and relevant regulations, including: <ul style="list-style-type: none"> - Annex 12 of Resolution No. 210 of 2001 – “Quality of Kuwait Seawater” - Chapter V of the Regulations for the Law on the Protection of the Environment of Kuwait • Water quality standards established by the EPA • International and regional conventions on the marine environment <p>Required Information and Its Sources</p> <ul style="list-style-type: none"> • National regulations, standards, and planning documents • Results of water quality samples conducted by the EPA • Information on the systems and equipment used to measure and monitor waste discharges and water quality, obtained through interviews with officials from the EPA and the Kuwait Institute for Scientific Research (KISR). 	<p>To examine the efforts of the EPA and other entities to monitor and protect seawater quality and address the causes of the Red Tide phenomenon, the SAB:</p> <ul style="list-style-type: none"> • Reviewed documentation related to the national plan for combating fish deaths and its implementation. • Interviewed officials from the EPA and other cooperating entities involved in water quality monitoring and Red Tide prevention activities. • Obtained external assistance and expertise from specialists at the KISR. • Conducted a scientific analysis of monthly water quality samples drawn by the EPA from a random selection of monitoring sites. The SAB then used a variety of statistical methods to compare the results against the established water quality standards and identify areas in which the standards were not being met. 	<p>The primary challenge reported by the SAB in conducting this audit was its inability to obtain water quality sample data for some locations the SAB had sought to include in its analysis.</p>	<p>As a result of this audit, the SAB identified several shortcomings in Kuwait’s efforts to prevent and address environmental problems—such as Red Tide—resulting from the pollution of its marine waters. For example, based on its review of relevant documentation and national plans, interviews with EPA officials, and consultations with external experts, the SAB concluded that Kuwait lacked an effective plan to overcome Red Tide and reduce its severity.</p> <p>Further compounding this planning problem were shortages in equipment, materials, and qualified personnel in the departments responsible for monitoring and addressing marine water pollution. Specifically, the SAB reported that its interviews with officials from the EPA and other entities revealed that inadequate equipment and, in some departments, the lack of a trained technical workforce, prevented or delayed the collection and analysis of some water quality samples.</p> <p>The impact of these problems and the overall shortcomings in EPA’s efforts to prevent marine pollution were particularly evident in the SAB’s analysis of water quality samples. In particular, the SAB uncovered numerous instances in which the samples exceeded acceptable pollution levels and failed to comply with water quality standards.</p>

^a A summary of this audit report is available at <http://www.environmental-auditing.org/tabid/126/CountryId/394/Default.aspx>.

3.2.7. PLANNING AND FINANCING FOR DRINKING WATER AND WASTE-WATER INFRASTRUCTURE

Acquiring adequate funding and developing effective plans to establish and maintain sufficient drinking water and wastewater infrastructure in a cost-effective manner is a governmental challenge that has increasingly drawn attention from SAIs. Whereas some SAIs have focused on the challenges associated with planning and financing large and complex water infrastructure projects, SAIs in other countries have paid more attention to their governments' efforts to install smaller, more decentralized water and wastewater treatment systems. Accordingly, audits in this issue area have analyzed the planning, financing, and maintenance activities for various types and scales of water infrastructure.

For example, in 2011 the SAI of Bhutan published an audit looking at efforts to improve water supply and sanitation through the financing, development, and installation of water and wastewater infrastructure, particularly in rural areas.⁶⁷ In this audit, the SAI examined small-scale infrastructure projects that had been funded in various municipalities and districts in Bhutan, in an effort to determine if resources had been used effectively and if water facilities were being managed and maintained appropriately in order to benefit their communities. The report noted that access to drinking water and improved sanitation coverage had increased significantly in the years prior to the audit. Nevertheless, the SAI still identified many locations that did not have proper sanitation facilities or featured facilities that had not been appropriately maintained, and uncovered numerous instances where rural water facilities were not functional.

At the multinational level, the European Court of Auditors released an audit report in 2010 that assessed the results of investments made by the European Union (EU) to develop drinking water infrastructure in Spain, Greece, Portugal, and Italy.⁶⁸ In particular, the SAI reviewed 29 projects designed to improve domestic water supply in these countries, with a focus on evaluating whether the EU funds were used to the best effect to improve water supply at the lowest cost to the EU budget. The SAI reported that the EU's investments had produced mixed results, noting that the EU funding had improved the supply of water for domestic use, but that better results could have been achieved at a lower cost through improved project management and better forecasting of future water needs.

FEATURE AUDIT: PERFORMANCE AUDIT OF URBAN WATER SUPPLY IN SIKKIM, INDIA

As presented in figure 19, in 2006 the SAI of India conducted an audit examining the efforts of the Water Security and Public Health Engineering Department (WS&PHED) to develop and effectively utilize the infrastructure necessary to provide drinking water to consumers in the state of Sikkim. Focused on projects and activities that occurred between 2001 and 2006, the SAI evaluated whether WS&PHED's investments in drinking water infrastructure were appropriate and efficient, and examined if it had ensured

the supply of safe and clean drinking water for the population. Additionally, the SAI sought to determine the extent to which the government in Sikkim had adopted and implemented beneficial water policies that were in accordance with national water management goals. To perform this evaluation, the SAI used a suite of complementary basic audit methods to uncover numerous deficiencies and areas for improvement in the performance of WS&PHED and the Sikkim state government.

⁶⁷ Royal Audit Authority of Bhutan, *Drinking Water Supply and Sanitation Audit*, 2011. (Note: this audit report can be obtained from the WGEA [website](#))

⁶⁸ European Court of Auditors, *Is EU Structural Measures Spending on the Supply of Water for Domestic Consumption Used to Best Effect?*, 2010. (Note: this audit report can be obtained from the SAI's [website](#))

FIGURE 19: AUDIT MATRIX FOR THE SAI OF INDIA'S "PERFORMANCE AUDIT OF URBAN WATER SUPPLY IN SIKKIM" REPORT^a

Objectives / Researchable Question(s)	Audit Criteria, Key Information Required, Source(s) of Information	Scope and Methodology	Challenges Encountered in Conducting the Audit	Audit Results and Key Findings
<p>The overall objective of this audit was to assess the efficiency and effectiveness of the Water Security and Public Health Engineering Department's (WS&PHED) efforts to provide sufficient and safe drinking water to consumers in the state of Sikkim. Addressing this objective required the audit team to evaluate:</p> <ul style="list-style-type: none"> the adequacy of WS&PHED's existing water treatment and delivery infrastructure, and the extent to which it was maintained; WS&PHED's efforts to ensure the sustainability of water sources; WS&PHED's plans for upgrading its water treatment and delivery infrastructure and its ability to finance necessary infrastructure investments; and the extent to which the Sikkim government had formulated and implemented policies to promote and support the achievement of drinking water goals. 	<p>Criteria</p> <ul style="list-style-type: none"> Targets and milestones established by the government. Established standards regarding water treatment, water quality, water infrastructure capacity, and infrastructure maintenance. Established provisions regarding the implementation of public works projects. <p>Required Information and Its Sources</p> <ul style="list-style-type: none"> WS&PHED records and documentation related to water infrastructure projects and associated expenditures. Information on the performance of WS&PHED in providing drinking water and the status of various water supply projects obtained through interviews with WS&PHED officials and responses to questionnaires. Photographic evidence of deficiencies in WS&PHED's water infrastructure was obtained during site visits. 	<p>This audit report evaluated whether WS&PHED had adequately planned, funded, implemented, and maintained sufficient infrastructure to provide safe drinking water to consumers in Sikkim from 2001 to 2006. As part of this review, the audit team examined in depth a sample of water supply projects and programs undertaken by WS&PHED during this time period. Specifically, to assess the performance of WS&PHED and audit these infrastructure projects, the team:</p> <ul style="list-style-type: none"> Analyzed project records, documentation, and data obtained from the WS&PHED headquarters and three out of five Divisional Engineers' offices. Interviewed senior WS&PHED officials and held group discussions with other stakeholders about the quality of drinking water and the infrastructure used to provide it to consumers in Sikkim. Distributed questionnaires to WS&PHED officials to obtain information on the status of water supply projects, the results they had achieved, and the extent to which targets were being met. Conducted site visits to observe and photograph deficient portions of WS&PHED's water treatment and delivery infrastructure. 	<p>This audit report did not identify any challenges encountered during the investigation.</p>	<p>This audit identified many areas of deficiency in the construction and management of drinking water infrastructure in Sikkim. In particular, the audit team's analysis of project records and data, as well as information obtained through questionnaires and interviews with WS&PHED officials, revealed that:</p> <ul style="list-style-type: none"> The Sikkim state government failed to formulate a State Water Policy as envisaged in the National Water Policy. Likewise, the State had not developed a plan to build capacity for increased water demand in the future or to preserve the State's water supply systems from the pressures posed by population growth and environmental degradation. WS&PHED determined its water charges for consumers without adequately analyzing or considering its operating and maintenance costs. Consequently, WS&PHED's annual revenue was consistently lower than its operating and maintenance expenses during the audit period, resulting in significant financial liabilities; WS&PHED incurred excessive and unnecessary expenses on many water infrastructure projects due to poor planning and project execution; WS&PHED failed to secure financial support from the local beneficiaries of its water projects, resulting in a loss of funds by the state government; and Despite losing a significant amount of water due to leakages and theft, WS&PHED had not established any effective monitoring or enforcement mechanisms to detect leaks or prevent unauthorized connections by consumers. <p>The audit also reported that shortcomings in WS&PHED's water infrastructure had resulted in consumers receiving poor quality drinking water and likely had contributed to an increase in water borne diseases in Sikkim. In particular, the en-route contamination of water being delivered to consumers was observed by the audit team during site visits and was illustrated in photographs in the audit report.</p>

^a This audit is available at http://saiindia.gov.in/ENGLISH/HOME/OUR_PRODUCTS/AUDIT_REPORT/GOVERNMENT_WISE/STATE_AUDIT/RECENT_REPORTS/SIKKIM/2006/CIVIL/CHAP_3.PDF (pg. 90)

3.2.8. IMPLEMENTATION AND ENFORCEMENT OF WATER LAWS

Many SAIs have devoted considerable attention to auditing how governments have implemented and enforced water-related laws and policies. In some instances, these audits evaluated whether governments have complied with the rules they set to govern their own actions, whereas in other cases SAIs assessed the enforcement of laws that target the actions of private entities (e.g., laws regulating the disposal of pollutants in water bodies).

Oftentimes, SAIs examined their governments' enforcement of water laws as part of audit investigations that focused on other subjects as well. For example, as part of its 2005 audit on the safety of drinking water, the SAI of Canada assessed whether Health Canada had complied with its legal obligation to inspect water quality on passenger trains, aircraft, and cruise ships.⁶⁹ On this matter, the audit found that while Health Canada appropriately inspected potable water on cruise ships and trains, it had failed to inspect water quality on aircraft due to funding issues. As a result, the SAI reported that Health Canada could not ensure the safety of the potable water provided to travelers on aircraft at the time the audit was conducted. A follow-up audit performed in 2009 revealed that Health Canada responded to the SAI's original report by beginning to inspect drinking water on some aircraft in 2006, however additional improvements were still needed to fully ensure the safety of water on all passenger airplanes.⁷⁰

FEATURE AUDIT: PERFORMANCE AUDIT REPORT ON FISHING INDUSTRY IN BOTSWANA BY FISHERIES DIVISION, BOTSWANA

Figure 20 features an example of an audit on the enforcement of laws governing the management of fish resources and the actions of fishermen, another common subject of focus for SAIs conducting work in this issue area. In response to growing domestic concerns about the protection and conservation of natural resources, the SAI of Botswana released a performance audit in 2005 focused on Botswana's domestic fishing industry. As part of this audit, the SAI investigated whether the government had developed enforceable fisheries regulations as required by law, and examined whether the Fisheries Division was carrying out routine

inspections and enforcing the rules designed to protect fish and their habitat. Notably, the SAI found that, amongst other things, key laws regarding the management of fish resources were not being fully enforced, and recommended increasing inspections of fishing activities to improve compliance and support the sustainability of fish resources. This report effectively illustrates how SAIs with more limited resources can use basic auditing tools—such as site visits, document reviews, and interviews in this example—to perform compelling enforcement-related water audits.

⁶⁹ Office of the Auditor General of Canada, *Safety of Drinking Water: Federal Responsibilities*, 2005. (Note: this audit report can be obtained from the SAI's [website](#))

⁷⁰ Office of the Auditor General of Canada, *Safety of Drinking Water*, 2009. (Note: this audit report can be obtained from the SAI's [website](#))

FIGURE 20: AUDIT MATRIX FOR THE SAI OF BOTSWANA’S “PERFORMANCE AUDIT REPORT ON FISHING INDUSTRY IN BOTSWANA BY FISHERIES DIVISION”^a

Objectives / Researchable Question(s)	Audit Criteria, Key Information Required, Source(s) of Information	Scope and Methodology	Challenges Encountered in Conducting the Audit	Audit Results and Key Findings
<p>Audit objectives included:</p> <p>1) To determine whether the Fisheries Division of the Department of Wildlife and National Parks had a fishing policy framework with clear priorities and objectives.</p> <p>2) To determine whether fishery resources were being exploited in a manner that was consistent with the principles of sustainable development and protection.</p> <p>3) To determine the extent to which information was being collected to develop sustainable long-term fisheries management plans.</p> <p>4) To assess the extent to which unregulated fishing activities result in ecological impacts and affect fish sustainability.</p> <p>5) To determine the extent to which the Fisheries Division was adhering to the requirements to protect the aquatic environment specified in the Southern African Development Community’s (SADC) Protocol on Fisheries.</p> <p>6) To assess whether the Fisheries Division was measuring the results and effectiveness of its actions to manage and protect fish and the environment.</p> <p>7) To determine the extent to which monitoring and routine inspections were conducted.</p>	<p>Criteria</p> <ul style="list-style-type: none"> • Legislation – (1) <i>Fish Protection Act of 1975</i>; and (2) <i>National Policy on Agricultural Development (Government Paper No. 1 of 1991)</i> • “National Development Plans” (numbers 7, 8, and 9) • Strategic plans for the Department of Wildlife and National Parks and the Department of Animal Health and Production • SADC Protocol on Fisheries <p>Required Information and Its Sources</p> <ul style="list-style-type: none"> • National legislation and planning documents • Documentation maintained by the Fisheries Division (e.g., Annual Reports) • Information from Fisheries Division officials about actions taken to manage and protect fish resources, obtained through interviews. • Information on the extent to which fishermen understand and implement practices to protect fisheries was obtained through interviews with fishermen, reviews of Fisheries Daily Catch Forms, and observations made during site visits. 	<p>To assess whether the Fisheries Division had an adequate policy framework and operational mechanisms to manage and protect fisheries and the fishing industry, the SAI of Botswana reviewed activities and data covering a three year period (fiscal year 2001/2002 through fiscal year 2003/2004).</p> <p>To conduct this audit, the SAI:</p> <ul style="list-style-type: none"> • Reviewed documentation, such as national legislation and policy documents, strategic plans, and Fisheries Division Annual Reports. • Reviewed data and other information from the forms completed by fishermen and used by the Fisheries Division to track the type and quantity of fish captured each day. • Interviewed Fisheries Division officials, including the Assistant Director, the Senior Scientific Officer, and 9 operational officers. • Conducted site visits to all 8 Fisheries Division Extension Areas and 5 fishing locations to observe the fishing practices being used and the impact they were having on the environment. <p>a) While conducting the site visits, the audit team also interviewed 46 fishermen to learn more about their interactions with the Fisheries Division, their use of the Fisheries Daily Catch Forms, and the extent to which the fishermen understood the need to protect fish and their habitat.</p>	<p>The lead auditor on this review reported that the audit team was unable to access some of the fishing locations it had hoped to visit due to the remote nature of the locations. Similarly, the auditor noted that accessibility was a challenge that the Fisheries Division also experienced in trying to carry out its mission in these areas.</p> <p>Furthermore, the lead auditor identified deficiencies in the reliability and accuracy of the Fisheries Daily Catch Forms as an additional challenge encountered during the course of the audit.</p>	<p>The results of this audit revealed that the Fisheries Division’s overall ability to protect fisheries and effectively manage fishing operations was impeded by several factors. In particular, by reviewing agency documentation and data, and interviewing Fisheries Division officials, the audit team determined that:</p> <ul style="list-style-type: none"> • The Fisheries Division had not developed a policy framework to guide the management, use, and protection of fish resources; • Fisheries regulations had not been finalized when this audit was conducted, despite originally being called for in the Fish Protection Act of 1975; • No management plans had been developed to establish safe harvesting levels for fish and encourage the sustainable use of this resource; and • No formal enforcement mechanisms were in place to protect fish and their habitat. <p>Additionally, by visiting fishing sites, reviewing daily catch forms, and interviewing fishermen directly, the audit team discovered that the fish catch data reported to the Fisheries Division were unreliable and incomplete, as many fishermen did not return the daily tracking forms or did not fill them out correctly.</p> <p>Nevertheless, the audit also found that the Fisheries Division had made some progress in developing the fish information database and in educating fishermen about how to sustainably use fish resources.</p>

^a This report is available at http://www.environmental-auditing.org/PORTALS/0/AUDITFILES/BW122ENG05AR_FT_FISHINGINDUSTRY.PDF

3.2.9.

CHALLENGES OF MANAGING WATER RESOURCES SHARED BY MULTIPLE NATIONS

In recognition of the challenges and complexities associated with addressing problems in water bodies that cross international borders, numerous SAIs have chosen to audit the effectiveness of their governments' efforts to manage water resources shared with other nations. Mirroring the cooperation that often occurs between governments in managing water resources that span multiple countries, some SAIs have also worked together to audit these multinational issues.

For example, in 2005 the SAIs of Austria and the Czech Republic performed coordinated audits concentrated on their respective governments' activities to improve water quality and support other environmental priorities in the Thaya River Basin.⁷¹ The Thaya River forms part of the border between these countries, and has been the focus of attention and expenditures by both countries designed to improve environmental conditions in the shared river basin. In addition to auditing each nation's use of funds and other measures designed to improve the environmental condition of the river basin, the SAIs also evaluated the transboundary cooperation between the two governments in this area.

FEATURE AUDIT: INTEGRATED MANAGEMENT PROJECT AND MASTER PLAN OF THE PILCOMAYO RIVER BASIN, ARGENTINA

Whereas some SAIs have collaborated together to conduct audits in this issue area, other SAIs have independently evaluated these matters. For instance, figure 21 presents detailed information on an audit by the SAI of Argentina focused on the management of water and other resources in a river basin shared between Argentina and two neighboring countries. The Pilcomayo River Basin extends over Argentina, Bolivia and Paraguay, and supports a population that primarily relies on the Basin's fish resources and subsistence agriculture for food. However, the Basin suffers from severe erosion and sedimentation processes that threaten its environmental sustainability and pose significant risks to the quality

of life of the Basin's inhabitants. In response, the three nations joined with the European Union in 2000 to finance a project to support activities to improve the Basin's natural environment and the livelihoods of its inhabitants. The results of this effort—known as the "Project of Integral Management and Master Plan of the Pilcomayo River Basin"—were subsequently evaluated by the SAI of Argentina in a 2011 report. In particular, this report focused on the role of Argentina's Sub-Secretariat of Water Resources in managing and implementing the project, and conveys findings and results primarily based on the SAI's extensive document analysis and interviews with officials.

⁷¹ Austrian Court of Audit and the Supreme Audit Office of the Czech Republic, *Coordinated Audits of Implementation of Tasks Related to Environmental Projects and Measures in the Thaya River Basin*, 2005. (Note: this audit report can be obtained from the WGEA [website](#))

FIGURE 21: AUDIT MATRIX FOR THE SAI OF ARGENTINA’S “INTEGRATED MANAGEMENT PROJECT AND MASTER PLAN OF THE PILCOMAYO RIVER BASIN” REPORT^a

Objectives / Researchable Question(s)	Audit Criteria, Key Information Required, Source(s) of Information	Scope and Methodology	Challenges Encountered in Conducting the Audit	Audit Results and Key Findings
<p>The overall objective of this audit was to examine the implementation of the international “Project of Integral Management and Master Plan of the Pilcomayo River Basin”. Specifically, the Auditor General of the Nation (AGN) of Argentina assessed the:</p> <p>1) development of studies and pilot works for water management;</p> <p>2) extent of progress in developing the Master Plan for the Integral Management of the Basin;</p> <p>3) development of the institutional governing body; and</p> <p>4) participation of local communities and institutions in the Project and the development of the Master Plan.</p>	<p>Criteria</p> <ul style="list-style-type: none"> • Legal agreements and other documentation related to the “Project of Integral Management and Master Plan of the Pilcomayo River Basin”, including: <ul style="list-style-type: none"> - Financial agreements - Various global and annual operating plans - Meeting minutes • International agreements, including the: <ul style="list-style-type: none"> - Formosa Declaration - Constituent Accord of the International Commission - Interjurisdictional Accord <p>Required Information and Its Sources</p> <ul style="list-style-type: none"> • Documents from international and domestic institutions involved in implementing the Project and developing the Master Plan. • Perspectives of officials from the Sub-Secretariat of Water Resources, obtained through interviews. 	<p>The AGN focused its evaluation of the “Project of Integral Management and Master Plan of the Pilcomayo River Basin” on the role of the Argentinean Sub-Secretariat of Water Resources in implementing the project. In particular, the scope of the audit covered the years from 2007 to 2009.</p> <p>The AGN used a variety of methods to examine the Sub-Secretariat of Water Resources’ management and implementation of the Pilcomayo River Basin Project. Most significantly, the AGN:</p> <ul style="list-style-type: none"> • Analyzed project-related documentation obtained from the Sub-Secretariat of Water Resources and other international and national institutions involved in the Project. Using a triangulation of information approach, the AGN contrasted documents from different sources to assess the validity of information obtained through its analysis of documentation. • Conducted interviews with officials from the Sub-Secretariat of Water Resources on the Sub-Secretariat’s management and implementation of the Project, as well as its experiences working with Bolivia and Paraguay in this area. Information obtained during interviews was also used to verify evidence collected during the audit team’s analysis of documentation. • Performed a legal analysis of applicable rules and regulations. 	<p>The AGN noted that it was sometimes challenging to focus its investigation exclusively on the role of the Argentina Sub-Secretariat of Water Resources without also venturing into issues regarding the other countries participating in the Project.</p>	<p>Based primarily on the results of the extensive document analysis and interviews, the audit team found that:</p> <ul style="list-style-type: none"> • The International Coordination Committee devoted to ensuring community participation in the Project was limited in its functioning due to the absence of established regular meetings with the Delegate Council; • The financial strategy for funding projects following the end of the agreement with the European Union was not initiated, causing a lack of assurance that the management of water resources and other natural resources would continue; • A Master Plan for managing the Pilcomayo River Basin was formulated but had not been validated by one of the countries (Bolivia) by the end of the audit period. Amongst other things, the plan states the importance of articulating scientific knowledge with the ancestral knowledge of native people living in the Pilcomayo River Basin, and promotes ample and inclusive participation in the Basin’s management; and • The approval of annual operational plans and the implementation of activities expected to start in 2009 were delayed.

^a This audit report is available (in Spanish) at http://www.agn.gov.ar/informes/informesPDF2011/2011_058.pdf

3.2.10.

ADEQUACY OF WATER-RELATED DATA

The adequacy of water-related data was a common theme covered by many SAIs auditing their governments' water activities.⁷² Broadly speaking, the audits included in this analysis focused on two main types of water-related data. First, several audits examined the sufficiency of data on water usage and demand. For example, as part of its 2005 audit on the management of fresh water resources, the SAI of New Zealand assessed the extent to which two regional councils had obtained adequate data for the purpose of monitoring compliance with water allocation agreements.⁷³ In particular, the SAI found that, due to inadequate data, neither council knew how much water was actually being used in their region. Consequently, the SAI reported that this gap in information reduced the ability of the councils to manage their water resources effectively.

Second, many SAIs focused their attention on the adequacy of data related to the quality and quantity of fresh water in their countries. For example, the feature audit presented below highlights an audit by the SAI of Canada of two government programs responsible for monitoring the quality and quantity of Canada's surface water resources.

FEATURE AUDIT: MONITORING WATER RESOURCES, CANADA

Fresh water resources play a critical role in many economic and industrial activities in Canada, and understanding the status and long-term trends in fresh water quality and quantity is necessary to effectively manage, protect, and utilize these resources. In this context, the SAI of Canada audited the Fresh Water Quality Monitoring Program and the National Hydrometric Program, examining the extent to which they had collected and made available to their clients high-quality data on water quality

and quantity. Upon its release in 2010, this audit received considerable media coverage, especially focused on the report's case studies of high profile issues, such as the deficiencies in data needed to monitor the water quality impacts of oil sands development. Figure 22 presents additional information about this report, its results, and the use of case studies and other methods employed by the SAI in this audit.

⁷² INTOSAI's WGEA has a guidance document titled, *Environmental Data for Auditors: Options and Resources*, which describes key issues for SAIs to consider when using environmental data to conduct audits.

⁷³ New Zealand Office of the Auditor-General, *Horizons and Otago Regional Councils: Management of Freshwater Resources*, 2005. (Note: this audit report can be obtained from the SAI's [website](#))

FIGURE 22: AUDIT MATRIX FOR THE SAI OF CANADA’S “MONITORING WATER RESOURCES” REPORT^a

Objectives / Researchable Question(s)	Audit Criteria, Key Information Required, Source(s) of Information	Scope and Methodology	Challenges Encountered in Conducting the Audit	Audit Results and Key Findings
<p>Objective 1 To determine whether Environment Canada applied a risk-based approach to plan, implement, check, and improve its Fresh Water Quality Monitoring Program and its National Hydrometric Program.</p> <p>Objective 2 To determine whether Environment Canada measured and reported on the progress of the Fresh Water Quality Monitoring Program and the National Hydrometric Program in achieving their planned results.</p>	<p>Criteria</p> <ul style="list-style-type: none"> The Office of the Auditor General of Canada (OAG) assessed each program’s management using the “Plan-Do-Check-Improve” management model according to Treasury Board of Canada Secretariat and other standards. Additional audit criteria were derived from applicable legislative mandates and federal/provincial water monitoring agreements. <p>Required Information and Its Sources</p> <ul style="list-style-type: none"> Program documentation maintained by Environment Canada. Internal audit of the National Hydrometric Program conducted by Environment Canada. Perspectives of departmental officials obtained through interviews. Perspectives of the clients of both programs obtained through an online survey. 	<p>This audit examined the management and performance of Environment Canada’s long-term surface water quality and quantity monitoring programs from fiscal year 2004-2005 to fiscal year 2009-2010.</p> <p>To conduct this audit, the OAG:</p> <ul style="list-style-type: none"> Reviewed program documentation Analyzed departmental activities and data quality for a sample of monitoring stations. Interviewed departmental officials at Environment Canada, including staff located at the department’s headquarters and at five regional offices. Surveyed clients of the two programs to determine the extent to which the monitoring programs were meeting the clients’ needs. OAG distributed an online survey to nearly 1,500 clients identified by Environment Canada. Survey respondents included, among others, officials from other federal government departments, provincial and municipal government entities, the private sector, and academics. Used case studies to highlight the performance of the programs and illustrate challenges the programs experienced related to prominent and timely issues, such as monitoring the water quality impacts of oil sands development. 	<p>Upon initiating this audit, the audit team found that Environment Canada had not systematically consulted with the clients of the two monitoring programs to determine their information needs. Since this information was not available from the audited department, the OAG decided to survey these clients.</p>	<p>By implementing these audit methods, the OAG found that, overall, Environment Canada was not adequately monitoring the quality and quantity of Canada’s surface water resources. In particular, the Department had not fully defined the extent of its water monitoring responsibilities, nor—as was illustrated in the audit’s case studies— had the Department located its monitoring stations based on an assessment of risks to water quality and quantity.</p> <p>In addition, the OAG found that neither program had determined whether they were satisfying client needs, nor had they taken the steps necessary to develop and implement plans to improve the programs. Through its survey of the programs’ clients, the OAG determined that the monitoring data produced by the programs were not fully meeting the needs of many users. The report also noted that the Fresh Water Quality Monitoring Program did not sufficiently validate the quality of the data it disseminated.</p> <p>According to the report, key impacts of these findings include:</p> <ul style="list-style-type: none"> Vast areas of territory under federal jurisdiction may not be subject to fresh water quality and quantity monitoring. Environment Canada did not know whether the greatest risks to water quality and quantity were being monitored. High-quality water monitoring data may not be available when and where it is needed by the programs’ clients.

^a This audit report is available at http://www.oag-bvg.gc.ca/INTERNET/DOCS/PARL_CESD_201012_02_E.PDF

3.2.11.

IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES

The relative newness of governmental activities in the area of climate change has presented challenges to the increasing number of SAIs interested in evaluating this emerging issue. For example, SAIs in countries that have taken few actions to address the water-related impacts of climate change may have limited potential lines of inquiry to pursue. In addition, SAIs in countries that have not established a legislative or legal framework covering these issues have experienced difficulties identifying appropriate criteria to use in audits on these topics. Nonetheless, many SAIs have begun to overcome these challenges in order to audit their countries' efforts to address or adapt to the water-related impacts of climate change.⁷⁴

In some cases, SAIs indirectly reported on these issues within audits focused on other subjects or as one component of audits that looked at climate change issues more broadly.⁷⁵ For example, as part of its 2010 audit on flood prevention and protection efforts, the SAI of Norway also examined the extent to which the government was considering the impacts of climate change in its flood-related planning and mapping activities.⁷⁶ Specifically, the report described how climate change may amplify future flood threats in Norway and revealed a need for the government to provide greater assistance and additional information on this subject to officials at the local level.

FEATURE AUDIT: ADAPTATION MEASURES FOR CLIMATE CHANGE SCENARIOS IN THE BRAZILIAN SEMI-ARID REGION REGARDING WATER SECURITY, BRAZIL

Whereas some SAIs have only indirectly covered climate change issues in their water-related audits, other SAIs have conducted audits that were entirely focused on climate change's expected impacts on water resources. Figure 23 presents information on an audit report published in 2009 by the SAI of Brazil on its government's efforts to ensure water security in the country's semi-arid region under different climate change scenarios. Spanning ten states, the Brazilian semi-arid region has been identified as highly vulnerable to the potential effects of climate change. In particular, climate change threatens to exacerbate the water shortages that already impact the region and

pose a threat to its approximately 22 million inhabitants. In response to concerns about these threats, the SAI examined the extent to which state and national government actions had taken into account different climate change scenarios and the risks they pose for water security in the semi-arid region. Highlighted by its effective use of site visits, the SAI used a variety of basic and more specialized audit tools to identify and report on shortcomings in these government efforts to prepare for and address the water-related impacts of climate change in the semi-arid region.

⁷⁴ In 2010, INTOSAI's WGEA published a document titled, *Auditing the Government Response to Climate Change: Guidance for Supreme Audit Institutions*, to assist SAIs interested in auditing climate change issues.

⁷⁵ See, for example, Office of the Auditor General of Canada, *Adapting to Climate Impacts*, 2010. (Note: this audit report can be obtained from the SAI's [website](#))

⁷⁶ Office of the Auditor General of Norway, *The Office of the Auditor General's Investigation into the Efforts of the Authorities to Limit Flood and Landslide Hazards*, 2010. (Note: this audit report can be obtained from the SAI's [website](#))

FIGURE 23: AUDIT MATRIX FOR THE SAI OF BRAZIL'S "ADAPTATION MEASURES FOR CLIMATE CHANGE SCENARIOS IN THE BRAZILIAN SEMI-ARID REGION REGARDING WATER SECURITY" REPORT^a

Objectives / Researchable Question(s)	Audit Criteria, Key Information Required, Source(s) of Information	Scope and Methodology	Challenges Encountered in Conducting the Audit	Audit Results and Key Findings
<p>The general purpose of this audit was to determine the extent to which government actions impacting water security in the Brazilian semi-arid region take into account the expected impacts of climate change.</p> <p>Specifically, the audit addressed the following questions:</p> <p>1) Have governmental institutions evaluated the vulnerabilities, impacts, and risks for water security in the semi-arid region resulting from possible climate change effects?</p> <p>2) Have governmental institutions developed public policies or taken other similar actions aimed to guarantee water security in the semi-arid region in response to the possible effects of climate change?</p> <p>3) Are the state institutions responsible for water resource management in the semi-arid region prepared to incorporate guidelines developed by the federal government to adapt to the impacts of climate change?</p>	<p>Criteria</p> <ul style="list-style-type: none"> • Law No. 9433/97 (Water Resources Law) • National plans and policies • National Water Resources Policy • National Plan Against Desertification • National Plan on Climate Change • National Policy for Solid Wastes • National Plan for Rural Sanitation • The Fourth Assessment Report of the Intergovernmental Panel on Climate Change <p>Required Information and Its Sources</p> <ul style="list-style-type: none"> • Planning documents and other documentation maintained by state and national agencies responsible for water resource management. • Perspectives of state and national government officials obtained through interviews and questionnaires. • Information on water infrastructure projects obtained through observations made during site visits. 	<p>This audit investigated efforts to protect water security in the semi-arid region from the possible impacts of climate change by examining the actions of a wide variety of national and state entities with responsibilities for water resource management.</p> <p>To perform this evaluation, the Brazilian Court of Audit:</p> <ul style="list-style-type: none"> • Convened an expert panel during the audit planning stage, consisting of technicians from the Ministry of the Environment, the Brazilian Agricultural Research Corporation, and a public regional development corporation, to review and validate the audit proposal and areas of inquiry. • Interviewed officials from state and national institutions involved in the management of water resources in the semi-arid region, as well as academics. • Reviewed documentation maintained by relevant state and national institutions. • Distributed a questionnaire to public officials involved in implementing policies related to water security and safety in nine states in the semi-arid region. The primary purpose of the questionnaire was to obtain information on actions taken by state institutions and their level of preparedness for adapting to the possible effects of climate change. • Conducted site visits in three states to observe water infrastructure projects, gather information from locals, and to corroborate information obtained during interviews with state and national officials. The audit team highlighted the site visits as being essential to the success of the audit. 	<p>The audit team reported experiencing difficulty obtaining responses to the questionnaire from many states. The Brazilian Court of Audit's mandate does not cover regional governments, and as a result, only four of the nine states responded to the questionnaire. Consequently, the SAI found that the survey proved to be a less effective method in this audit than had originally been expected.</p>	<p>Through the implementation of these audit methods, the Brazilian Court of Audit determined that national and state governmental institutions did not sufficiently understand the risks to water security posed by climate change in the semi-arid region, nor had they adequately prepared for or taken actions to address possible climate change effects. Based primarily on the results of its interviews with officials, analysis of documentation, and information obtained during site visits, the audit team found that:</p> <ul style="list-style-type: none"> • Roles and responsibilities regarding climate change were dispersed among several public institutions and were not clearly defined; • No climate change risk assessments regarding water security and safety had been prepared for the semi-arid region; and • Government policies and actions related to water management and distribution in the semi-arid region were not taking into account the potential impacts of climate change, and were thus at risk of being inefficient and ineffective. <p>Given the potential for climate change to aggravate existing water shortages in the semi-arid region, the audit concluded that these shortcomings in government planning and actions may expose the population living in the semi-arid region to future risks.</p>

^a This report is available at <http://www.environmental-auditing.org/tabid/126/CountryId/410/Default.aspx>

4.

AUDITOR'S TOOLBOX: HOW VARIOUS AUDIT METHODS HAVE BEEN SUCCESSFULLY APPLIED TO ADDRESS A RANGE OF WATER ISSUES

INTRODUCTION

Whereas chapter 3 provided a water issue-by-issue discussion, illustrating how each issue has been audited by members of the SAI community, this fourth chapter focuses more directly on the audit tools themselves—examining in particular the circumstances under which various audit methods have been effectively used to produce compelling results. In addition to relying on a detailed examination of the audit tools used in the analyzed water-related audits, the information in this chapter is derived from interviews with some of the auditors who prepared the audit reports and from methodological literature, including INTOSAI guidance documents.

As illustrated in figure 24, the analysis presented in this chapter shows that the tools SAIs have used to audit water-related issues can generally be grouped into two broad categories, based on their frequency of use and the level of resources (and in some cases expertise) they require. The Project Team’s review of 105 audits suggests that even for SAIs with the most experience in conducting performance audits of water-related issues, *basic audit tools often provide audit teams with their most useful observations and compelling findings. Such basic tools, outlined in the left column below, have been widely used by a broad range of SAIs with varying performance audit capabilities and experiences. At the same time, the more specialized audit tools in the right column have been successfully used in many instances to substantiate the audit findings derived from the basic tools, and in some cases to address specific issues for which the basic tools alone may be insufficient (e.g., issues requiring economic or scientific expertise, or policy issues for which defined audit criteria are not available).*

FIGURE 24: AUDITOR’S TOOLBOX

Basic Audit Tools	More Specialized Audit Tools
Interviews	Expert panels
Documentation reviews	Focus groups
Site visits	Database analyses
Questionnaires and surveys	Economic analyses
Case studies	Scientific analyses ^a
Obtaining expert opinions	International benchmarking ^b

^a Scientific analyses may include, for example, the taking and analysis of water samples.

^b International benchmarking involves comparing the audited entity’s programs or activities against similar programs or activities that have been implemented in other comparable countries.

In describing the tools listed in figure 24, this chapter provides (1) a general definition for each and the frequency and the circumstances in which they have been used among the universe of audits examined, and (2) an illustration of the tool’s use from among the 105 audits. The chapter concludes with observations on the overall value of each category of audit tools for SAIs looking to expand—or in some cases, initiate—their work on water-related issues in the future.

4.1. BASIC AUDIT TOOLS

Each of the basic audit tools in figure 24 are individually discussed and illustrated below. It is important to note, however, that SAIs have generally used combinations of these tools together to audit water-related issues. Using multiple audit tools concurrently has allowed SAIs to conduct more comprehensive audits that evaluate a topic from multiple perspectives, and has also helped auditors overcome the inherent limitations associated with many individual audit tools.

4.1.1. INTERVIEWS

Interviews with government officials, affected parties, and program staff were among the most commonly used tools by SAIs, featured as a key audit method in more than 90 percent of the reports analyzed by the Project Team. Interviews were instrumental to audit teams in all audit phases. At the beginning of an audit, interviews helped audit teams understand the status of programs, recent program changes, and/or upcoming events that may require changes. Near the end of an audit, interviews helped some audit teams confirm information or identify contradictory information from other sources.⁷⁷

According to the Project Team’s conversations with SAIs and review of methodological literature,⁷⁸ the advantages of interviews as a primary audit technique include allowing the audit team to:

- Access an individual’s knowledge and skills;
- Understand institutional memory;
- Obtain undocumented knowledge;
- Obtain leads and anecdotes;
- Generate and assess ideas and suggestions; and
- Confirm information or corroborate other evidence.

There are some limitations, however, when relying solely on interviews for evidence. According to several SAI audit teams interviewed by the Project Team, interviews are based on trust. Evidence obtained through them can sometimes be unreliable because perceptions differ, time fades or skews memory, stress or other distractions can alter memory, or respondents may stretch the truth for any number of reasons. In addition, it may be challenging to identify all key stakeholders and gather their opinions on audit issues, according to one SAI. Consequently, audit teams primarily relying on interviews often used other audit tools to confirm key findings.⁷⁹

FEATURE AUDIT: THE AUSTRALIAN NATIONAL AUDIT OFFICE USED INTERVIEWS TO SHOW THE EXTENT OF CHALLENGES WITH DROUGHT ASSISTANCE PROGRAMS

In 2011, a report by the Australian National Audit Office examined drought assistance measures in the Australian Department of Agriculture, Fisheries, and Forestry. (Additional information on the background, objectives, and results of this audit is available in the chapter 3 “Drought” subsection and in figure 15 of this report.) Interviews helped the audit team show the effects of drought conditions on specific areas, as well as the nature and extent of challenges that farmers had experienced with the delivery of government assistance. The audit team interviewed a wide variety of stakeholders relevant to the drought assistance programs, including departmental officials and partnering agencies at the state (e.g., state agriculture departments) and national levels, representatives of agricultural organizations, rural financial counselors, and individual farmers impacted by the drought.

While the audit team also used other audit methods, it noted that its interviews with farmers

were vital in producing some of its most compelling results. The interviews helped show the heavy emotional and financial toll that drought takes on farmers. The interviews also helped highlight the importance of the drought assistance measures for many rural communities and agricultural enterprises and the implications of government decisions and the timing of such decisions. For example, interviews showed that ministerial decisions have significant effects on farmers and small businesses experiencing drought because such decisions—for example, an “exceptional circumstances” declaration—give farmers and small businesses access to income support, interest rate subsidies, and grants. In addition, interviews helped show farmers’ concerns with the implementation of the pilot program.

(Note: this audit report can be obtained from the SAI’s [website](#))

⁷⁷ Interviews using structured approaches are described under the Project Team’s analysis on questionnaires and surveys later in this chapter.

⁷⁸ For example, see INTOSAI, *Performance Audit Guidelines: ISSAI 3000 – 3100* (Denmark, 2004).

⁷⁹ For audits relying solely on interview evidence, audit teams are encouraged to identify the appropriate threshold of testimonial evidence that is needed for generating findings on the basis of interviewees’ perceptions, according to several SAI audit teams interviewed by the Project Team.

4.1.2. DOCUMENTATION REVIEWS

Documentation reviews were featured as a key audit method in more than 95 percent of the audits reviewed by the Project Team, and proved to be among the most basic yet effective of audit tools. Analyzing documents and files often provides an efficient way of collecting data, and their review forms the basis of many performance audits. The Project Team found that documentation reviews took different forms. In many instances, audit teams obtained information from program files or reports to verify the accuracy of testimonial or other documentary evidence. In other instances, audit teams reviewed program files at local levels to identify the beneficiaries of program resources, challenges they encountered, and the extent to which the program is implemented in accordance with headquarters' guidelines. When used alone, documentation reviews may lack the context that is needed to understand program implementation. As a result, audit teams have typically combined documentation reviews with other audit tools, such as interviews and site visits.

FEATURE AUDIT: INDIA'S COMPTROLLER AND AUDITOR GENERAL'S REVIEW OF KEY DOCUMENTS AND REPORTS REVEALED LAPSES IN POLLUTION CONTROL PROGRAMS

In 2005, the Comptroller and Auditor General of India issued a report titled, "Measures to Control Water Pollution in River Yamuna in Delhi," in which the audit team used document and file reviews to show problems with the effectiveness of sewage treatment control programs. Specifically, the audit team examined pollution treatment records from the agency in charge of construction and maintenance of sewage treatment plans and pumping stations. The team then compared the information in these records to the agency's annual and strategic plans. In addition, the audit team checked treatment plant records on the extent of onsite inspections at 16 sewage treatment plants. Finally, the audit team studied assessment reports conducted by outside agencies to assess the overall impact of the measures undertaken for treatment of residential and industrial sewage.

The team's document and file review helped show that, despite over ten years of government investment in sewage treatment infrastructure, water quality had worsened in the area and large amounts of untreated sewage still entered the river. For example, water quality reports showed that the

River Yamuna's water quality just upstream from Delhi was adequate to sustain aquatic life and conformed to bathing standards. However, at the point of its exit from Delhi, documents showed that the river's water quality was unfit for any purpose. Moreover, document and file review helped show that the government had created sewage treatment capacity for only 70 percent of the sewage generated, yet the treatment capacity was not fully used. As a result, less than 50 percent of the sewage generated was ultimately treated, with the remainder discharged directly into the river. Finally, the audit team found that the quality of treated sewage did not meet specifications and therefore contributed to degraded water quality. On the basis of the extensive document review, the audit team made a number of recommendations to the Government of Delhi to improve internal controls governing its sewage treatment practices.

(Note: this audit report can be obtained from the SAI's [website](#))

4.1.3. SITE VISITS

Site visits were used in approximately 60 percent of the audits reviewed by the Project Team. They have proven to be among the most effective methods to understand how a government program operates at the local level, obtain the views of staff or program beneficiaries in the field, discuss and test ideas, and make comparisons with information from other sources.⁸⁰ They have been effectively used at nearly all audit stages—in the early stages to test initial assumptions and identify key issues for evaluation,⁸¹ and in the later stages to determine whether and to what extent programs are working at the local level.⁸² One notable use of site visits identified in methodological literature is to help auditors better understand cause-effect relationships.⁸³ For example, to determine a program’s impact, audit teams could visit sites where the program has been implemented and compare their findings from these visits to the results from other sites where the program had not been implemented.

The audits analyzed by the Project Team show the importance of site selection. In some cases, for example, audit teams chose sites that were representative of an issue, and in other cases audit teams chose sites that demonstrate a particularly noteworthy aspect of program implementation. Based on a review of audit design guidance issued by the SAI of the United States, the Project Team identified six types of site visits that can be considered in different audits and for different purposes.⁸⁴

1. *Illustrative*. Descriptive in character and intended to add in-depth, real world examples to other information about a program or policy.
2. *Exploratory*. Also descriptive in nature, but aimed at generating hypotheses for later investigation rather than illustrating descriptive information.
3. *Critical instance*. Examines a single instance of unique interest or serves as a critical test of an assertion about a program, problem, policy, or strategy.
4. *Program implementation*. Investigates operations, often at several locations, and compares implementation to what should be occurring.
5. *Program effects*. Examines causality and usually involves multiple sites and other methods to assess cause.
6. *Cumulative*. Brings together findings from many site visits to answer an evaluation question and can be descriptive, normative (i.e., how the program *should* work), or cause-effect.

⁸⁰ INTOSAI, *Performance Audit Guidelines: ISSAI 3000 – 3100* (Denmark, 2004).

⁸¹ See, for example, Office of the Auditor General of Botswana, *Performance Audit Report on Fishing Industry in Botswana by Fisheries Division*, 2005. (Note: this audit report can be obtained from the WGEA [website](#))

⁸² See, for example, New Zealand Office of the Auditor General, *Local Authorities: Planning to Meet the Forecast Demand for Drinking Water*, 2010. (Note: this audit report can be obtained from the SAI's [website](#))

⁸³ INTOSAI, *Performance Audit Guidelines: ISSAI 3000 – 3100* (Denmark, 2004).

⁸⁴ United States Government Accountability Office, *Case Study Evaluations*, GAO/PEMD-91-10.1.9 (Washington, D.C., 1990); and United States Government Accountability Office, *Designing Evaluations*: 2012 Revision, GAO-12-208G (Washington, D.C., 2012).

Figure 25: Flood Discharge Capacity (13 Culverts) at Kigongoni Outlet in 1991, Which Accommodated Only 25 Percent of the Estimated Flood Flow of the 1990 Flood (left). The Flood Discharge Capacity Remained Unchanged in 2005 (13 Culverts) at the Kigongoni Outlet (right).



Source: National Audit Office of Tanzania.

FEATURE AUDIT: THE NATIONAL AUDIT OFFICE OF TANZANIA USED SITE VISITS TO SHOW THE STATUS OF INFRASTRUCTURE FOR FLOOD PREVENTION AND MITIGATION

In 2007, the National Audit Office of Tanzania issued a report titled, “A Performance Audit of the Management of Prevention and Mitigation of Floods at Central, Regional and Local Levels of the Government of Tanzania — A Case Study of Floods in Babati.” (Additional information on the background, objectives, and results of this audit is available in the chapter 3 “Flooding” subsection and in figure 16 of this report.) According to the audit team, site visits to Babati were the most useful of the numerous audit methods used in this review. The audit team chose to focus on this location because of its usefulness in highlighting critical flood prevention issues. Because this audit focused on the adequacy of infrastructure maintenance necessary for dealing with floods, physical observations of existing flood prevention infrastructure gave the audit team a clear picture on how the Babati District Council and the Department of Disaster management were ensuring infrastructure maintenance. The auditors took a number of photos during the site visits and compared those photos to ones taken when floods previously occurred in 1990 and 1998 to illustrate

ongoing problems with the flood prevention infrastructure (see fig. 25). Information and photographic evidence obtained during site visits proved to be the most critical evidence for concluding that flood prevention infrastructure maintenance was inadequate.

Through physical observations made during site visits, the audit team was able to develop an understanding of the situation and the type of evidence that can be suitable for building key audit findings. Moreover, the audit team found local residents to be very knowledgeable about their environment, and they provided very good information on where they thought the government went wrong. In particular, the audit team was able to obtain information from local stakeholders showing how little had been done to improve disaster management after the floods of 1990 and 1998.

(Note: this audit report can be obtained from the WGEA [website](#))

4.1.4.

QUESTIONNAIRES AND SURVEYS

Among the SAI audits reviewed by the Project Team, questionnaires or surveys were used as a primary tool about 35 to 40 percent of the time.⁸⁵ They were particularly useful when audit teams needed to quantify information from a large number of individuals on a specific issue or topic. SAIs used questionnaires and surveys to systematically obtain judgments and views about processes, performance, and program adequacy, efficiency, and effectiveness. For instance, as part of the SAI of the Slovak Republic's 2011 audit on governmental flood protection efforts, the audit team developed a questionnaire to obtain information on the capacity and capability of local authorities to fulfill their flood protection responsibilities.⁸⁶

According to INTOSAI performance audit guidelines and the Project Team's interviews with auditors from different SAIs, surveys tend to have a higher potential for error in responses and, in many cases, are affected by a low response rate.⁸⁷ Consequently, SAIs typically supplemented information obtained through questionnaires and surveys with other audit tools, such as interviews, site visits, or documentation reviews.

FEATURE AUDIT: BOTSWANA'S OFFICE OF THE AUDITOR GENERAL USED QUESTIONNAIRES TO EXAMINE THE MAINTENANCE OF URBAN WATER SUPPLY BY THE WATER UTILITIES CORPORATION

In 2004, the Office of the Auditor General of Botswana issued a performance audit evaluating the Water Utilities Corporation's maintenance of the infrastructure used to provide water to urban areas. The audit team used several complementary audit tools to address the audit's objectives, including a questionnaire to obtain customer views on the Corporation's performance and the extent to which certain problems occurred. The team used a survey in part because, during the course of its review, it obtained information that contradicted Corporation officials' statements—particularly as it related to maintenance at dams and water treatment facilities. To help test the validity of the conflicting information, the audit team distributed the questionnaire in person to 100 customers to assess opinions of the Corporation's performance in conducting maintenance and serving customer needs. In particular, the questionnaire focused on the extent to which the Corporation had responded

to customer problems and concerns. To ensure a high response rate, the audit team collected completed surveys in person the following day.

The audit manager said that some of the most compelling findings about systemic shortcomings in the Corporation's performance resulted from information obtained through the questionnaires. Customers' opinions on maintenance practices helped the audit team seek additional information from the Corporation. Ultimately, this information helped the audit team show that the corporate plans needed to provide overall direction for maintenance practices had not been prepared.

(Note: a summary of this audit report can be obtained from the WGEA [website](#))

⁸⁵ Structured interview approaches have many of the same characteristics as questionnaires and surveys but involve direct communication with the interviewee.

⁸⁶ Supreme Audit Office of the Slovak Republic, *Governance of Public Funds Allocated for Flood Protection and Elimination of the Consequences*, 2011.

⁸⁷ INTOSAI, *Performance Audit Guidelines*: ISSAI 3000 – 3100 (Denmark, 2004).

4.15. CASE STUDIES

Between 35 and 40 percent of the audits reviewed by the Project Team involved some form of case study approach as part of their methodology. Case studies and site visits are similar, and audit teams often selected them on the basis of similar criteria. The Project Team’s analysis found that audit teams often used case studies further along in the audit (i.e., after the audit design was complete) and when they wanted to study one particular case or location in depth.⁸⁸ Case studies were particularly effective in drawing attention to a problem, and proved to be useful in getting in-depth information and insights into the nature of an audit problem and its root causes. They provided convincing evidence that was easily remembered by audits’ readers. The Project Team found that this audit tool helped several SAIs obtain convincing and “attention-getting” information.⁸⁹ In the Project Team’s review of audits, case studies generally involved a combination of basic audit tools, including interviews, site visits, and file reviews at, or in regard to, specific locations or events.

The Project Team’s review of audits that used case studies also showed that one challenge is determining how to use the specific cases in effective ways to complement other audit methods. According to audit design guidance issued by the SAI of the United States, there are three general bases for selecting case studies (see table 1).⁹⁰

Selecting the appropriate case study is crucial to generalizability and to answering the evaluation questions appropriately. The review of audits showed that only rarely was convenience a sound basis for selecting a case study, and only rarely was probability sampling feasible. Thus, most case studies in the audits reviewed were selected on the basis of purpose, with most audit teams choosing to highlight special interest cases or representative cases.

TABLE 1: CASE STUDY SELECTION BASES

Selection basis	What questions it can answer
Convenience (e.g., selected on the basis of ease of data collection)	“In this site, what is happening and why?”
Purpose (e.g., selected on the basis of a program’s goals or objectives)	
• Bracketing	“What is happening at the extremes? What explains such differences?”
• Best cases	“What accounts for an effective program?”
• Worst cases	“Why isn’t the program working?”
• Cluster	“How do different types of programs compare with each other?”
• Representative	“In instances chosen to represent important variations, what is the program like and why?”
• Typical	“In a typical site, what is happening and why?”
• Special interest	“In this particular circumstance, what is happening and why?”
Probability sampling (e.g., selecting a sufficient number of cases so that results are generalizable)	“What is happening in the program as a whole and why?”

Source: U.S. Government Accountability Office

⁸⁸ In addition, case studies may involve a more in depth and structured analysis of program implementation than site visits.

⁸⁹ See, for example, Ghana Audit Service, *Performance Audit Report of the Auditor-General on the Provision of Safe Drinking Water*, 2006. (Note: this audit report can be obtained from the SAI’s [website](#).)

⁹⁰ GAO, *Case Study Evaluations*, GAO/PEMD-91-10.1.9 (Washington, D.C., 1990).

FEATURE AUDIT: THE OFFICE OF THE AUDITOR GENERAL OF CANADA USED CASE STUDIES TO HIGHLIGHT KEY REGIONAL ISSUES WITH FRESH WATER MONITORING PROGRAMS

In 2010, the Office of the Auditor General of Canada issued a performance audit of Environment Canada's programs for monitoring surface fresh water quantity and quality. (Additional information on the background, objectives, and results of this audit is available in the chapter 3 "Adequacy of Water-Related Data" subsection and in figure 22 of this report.) In addition to using other methodological approaches in this audit, the SAI conducted case studies on pollution in Lake Winnipeg and on the impacts of oil sands development on water quality to help illustrate its findings. The audit team selected Lake Winnipeg as a case study because of the government's high level of interest and investment in the water body (i.e., selected because it was of special interest). The oil sands case study was identified based on the results of the audit team's literature review and interviews with officials, which indicated the

importance to the public of water issues in this area (i.e., selected because of its special interest status).

A member of the audit team said that of the different methodological approaches used, the case studies were a cost effective method that allowed the audit team to explore salient regional issues in greater depth without incurring significant additional costs. Furthermore, by focusing the case studies on high profile topics, this method prompted the public, media, and government to pay greater attention to the results of the audit than would have likely occurred otherwise.

(Note: this audit report can be obtained from the SAI's [website](#))

4.1.6. OBTAINING EXPERT OPINIONS

Among the water-related audits reviewed by the Project Team, nearly 25 percent involved obtaining expert opinions. The Project Team's analysis showed that using well-respected experts to provide educated opinions about the effects of different program or policy options can greatly enhance the credibility of an audit's findings. Audits teams often used experts to make technical knowledge or skills that were necessary for answering the audit questions available to the audit team. Obtaining individual expert opinions has been shown to be a relatively cost effective method for SAIs to use.

FEATURE AUDIT: THE OFFICE OF THE AUDITOR GENERAL OF THAILAND USED EXPERTS TO FIND FLAWS IN COASTAL EROSION MANAGEMENT AND PROTECTION PROGRAM

In 2008, the SAI of Thailand issued a report titled, "Audit on the Coastal Erosion Management and Protection: The Thai Experience." In Thailand, coastal erosion in recent years has caused the loss of coastal areas, communities, homes, and jobs. According to the report, there are many direct and indirect factors that contributed to coastal erosion, including mangrove forest intrusion, coastal area construction and development, and climate change. The Ministry of Natural Resources and Environment administers the National Strategy for Management of Coastal Erosion. With the national strategy, the Ministry is to integrate coastal erosion management and related activities throughout all levels of government. The audit's objectives were to (1) assess the national strategy and associated annual plans, (2) compare actual performance with targets, and (3) identify the strategy's key

challenges, if any.

The audit team collaborated with two experts in the field of coastal management and oceanography. In the planning phase, the two experts helped determine the audit's scope and areas of high risk with respect to coastal management. In the analysis phase, the experts assessed the merits of the audit team's analysis and provided technical advice. The use of experts helped the audit team find that Ministry officials did not use key environmental assessments when developing the national strategy, which may inhibit the program from achieving certain performance targets. The team also found that overlap existed between certain government programs related to surveying coastal erosion.

4.1.7. COMBINATIONS OF BASIC AUDIT TOOLS

While the examples above speak to the strengths and weaknesses of individual audit tools, the Project Team found that SAIs generally used combinations of audit tools together to audit water-related issues. Using multiple audit tools concurrently allowed SAIs to conduct more comprehensive audits that evaluated a topic from multiple perspectives, and also helped auditors overcome the inherent limitations associated with many individual audit tools.

For example, in situations where there was a risk that officials were biased or untruthful in their interview responses, audit teams often used site visits and documentation reviews to confirm the validity of the officials' statements. In addition, when site visits uncovered potential problems in implementing government-sponsored programs, surveys or questionnaires were often used to ascertain the extent to which potential problems occurred across the program area. Table 2 provides information on the advantages and limitations of basic audit tools, along with examples of combinations of tools that can help overcome the limitations of using basic tools in isolation.

TABLE 2: ADVANTAGES AND LIMITATIONS OF BASIC AUDIT TOOLS AND OPTIONS FOR OVERCOMING LIMITATIONS

Method	Purpose	Advantages	Limitations	Options for Overcoming Limitations
Interviews	When auditors need to fully understand someone's impressions or experiences.	Can obtain full range and depth of information. Offer flexibility in questioning.	Can be hard to analyze and compare. Are generally the weakest form of evidence.	Auditors can verify interview evidence by using site visits or documents showing program implementation at local levels.
Documentation reviews ¹	When auditors need an impression of how a program operates at a broad level and what a program accomplishes.	Often provide comprehensive and historical information. Are less susceptible to information biases than other methods	Inflexible; data are restricted to what already exists. Usually high-level; do not show how a program is implemented.	Auditors can use site visits or case studies to give context to summary information and data from documents to show how a program is implemented.
Site visits	When auditors need to gather accurate information about how a program operates at the local level and how processes are implemented.	Can view program operations as they are actually occurring.	Can be difficult to categorize and generalize observations. Can influence participants' behavior	Auditors can use questionnaires to help categorize observations from site visits and to show breadth of key themes.
Questionnaires and surveys ²	When auditors need to efficiently obtain a great deal of comparable information from people.	Can be done inexpensively and anonymously. Responses can often be easily compared and analyzed. Can obtain large amounts of data.	Responses do not always provide full story. Wording can bias responses. Might not receive careful feedback.	Auditors can use case studies or site visits to provide context to survey information.
Case studies	When auditors need to draw attention to a problem and get in-depth insights.	Can obtain convincing information. Can enhance the credibility of audit findings.	Do not always provide clear criteria or program mandate. Not generalizable.	Auditors can use document reviews and interviews with program officials to obtain program criteria.
Obtaining expert opinions	When auditors need specialized technical knowledge or skills to address audit objectives.	Is relatively cost-effective	Information obtained is typically qualitative and cannot be generalized.	Auditors can use surveys or case studies to help show breadth of key themes.

Source: Project Team's analysis of the audits reviewed for this report, together with INTOSAI performance audit guidelines and other elements of methodological literature.

¹ Auditors often use documentation from the audited entity and compare it to documentation from secondary sources, such as nongovernmental organizations, to better understand program operations, accomplishments, and areas for further examination

² It is often easier to compare responses to questionnaires and surveys using multiple choice options than those using open-ended questions to collect qualitative information.

4.2. SPECIALIZED AUDIT TOOLS

The Project Team’s analysis identified many instances where the types of more specialized tools presented in figure 24 can be particularly useful. For example, they can often complement the more basic tools by providing greater analytical depth to audits of complicated issues or by helping to substantiate controversial audit findings. These tools often require more resources and greater technical capabilities than the basic audit tools, and consequently their use is not always feasible or desirable. The descriptions below define each tool, providing information on different circumstances in which they can be applied; indicate the frequency with which they were used among the audits reviewed by the Project Team; and provide examples of audits that have successfully used them to evaluate key water-related issues.

4.2.1. EXPERT PANELS

Among the water-related audits reviewed by the Project Team, just under 5 percent employed an expert panel to systematically obtain expert opinions. Several SAIs showed that using expert panels was particularly valuable when evaluating emerging or otherwise complex issues (e.g., legal or scientific topics) for which SAIs may lack in-house expertise.

The use of expert panels differs from the more frequently-used consultation of individual experts (as described previously in the discussion of basic audit tools) in that an expert panel can allow an audit team to quantify information that is often qualitative, thus lending greater weight to audit findings. Using expert panels to systematically obtain expert opinion often proved to be more resource intensive, but also enhanced methodological rigor. In general, members of the expert panels were selected based on specific experiences or areas of subject-matter expertise.

FEATURE AUDIT: THE UNITED STATES GOVERNMENT ACCOUNTABILITY OFFICE USED A WEB-BASED PROGRAM TO OBTAIN CONSENSUS FROM A “VIRTUAL” PANEL OF EXPERTS

In 2003, the United States Government Accountability Office conducted a Web-based Delphi survey process involving a panel of 43 nationally recognized experts. The Delphi method is a systematic process for obtaining individuals’ views and seeking consensus among them, if possible, on a question or problem of interest. The subject of inquiry was how federal funds could best be spent to help ensure the security of the nation’s drinking water supplies. Significant federal funding had been provided to help drinking water utilities assess their vulnerabilities to terrorist threats and develop response plans.

The Delphi method is generally used in face-to-face group discussions, but for this study the audit team administered it through the Internet. Specifically, the audit team conducted a three-phase, Web-based survey of the experts to identify (1) the key security-related vulnerabilities affecting the nation’s drinking water systems; (2) the criteria that should be used to determine how federal funds are allocated among recipients to improve their security, and the methods that should be used to distribute these funds; and (3) specific activities the federal government should support to improve drinking water security. The

audit team identified these experts from a larger group of widely recognized experts in one or more key aspects of drinking water security. Of the 50 experts contacted, 43 agreed to participate and complete all three phases of the survey.

Administering the Delphi method through the Internet eliminated the potential bias associated with group discussions. These biasing effects include the dominance of individuals and group pressure for conformity. Moreover, by creating a virtual panel, the audit team was able to include many more experts than possible with a live panel, which allowed the team to obtain a broad range of opinions from a wide range of experts, reflecting different orientations and viewpoints. The approach proved to be highly successful in identifying areas of greatest vulnerability and options for the effective use of federal funds. The use of the Delphi method allowed the audit team to push the expert panel participants toward consensus on key issues.

(Note: this audit report can be obtained from the SAI’s [website](#))

4.2.2. FOCUS GROUPS

Just under 5 percent of the audits reviewed by the Project Team included focus groups as a key component of their methodology. Most focus groups involved small groups of individuals (generally, between seven and twelve individuals) meeting for a specified period of time to discuss program implementation, challenges, or potential program changes.⁹¹ Most of these meetings were in person, but some were held over the Internet or in some venue other than a conventional face-to-face meeting. Members of focus groups were generally selected on the basis of specific characteristics, such as their particular experiences relevant to the audit's subject or a particular stake they may have in the issue at hand.⁹² Focus groups helped audit teams explore topics in depth and find areas of common understanding, while generally enhancing the credibility of audit findings.

FEATURE AUDIT: ESTONIA'S NATIONAL AUDIT OFFICE USED A FOCUS GROUP TO BRING ATTENTION TO PEAT EXPLOITATION AND ASSOCIATED WATER USE ISSUES

In 2005, the National Audit Office of Estonia issued an audit report on the exploitation of peat resources. The audit team used several different audit techniques, including interviews, data analysis, and questionnaires to assess whether the state ensures a sustainable use of peat reserves. According to the audit team, however, the use of a focus group was the most useful method in generating audit findings that led to practical recommendations. The focus group met twice and was comprised of industry specialists, local stakeholders, and state officials. In the first meeting, participants discussed whether peat should be treated as a renewable or non-renewable natural resource and the impact this characterization has on the environment, as well as the process for preparing environmental impact assessments in the course of issuing extraction permits. In the second meeting, participants discussed taxation of use of peat resources and the impact of possible changes on the activity of peat extraction and the environment, as well

as possibilities for rehabilitating abandoned production areas.

The focus group helped initiate discussion among potentially affected parties—who had not previously met together—to discuss the often conflicting interests of protection of wetlands and exploitation of peat resources. The focus group also helped to show that the issue of peat exploitation had been neglected by the Ministry of Environment, and to generate public support for the recommendations that the National Audit Office made to the Ministry. According to the audit manager, this audit helped make meaningful changes to the permitting process and environmental impact assessments. Further, the Ministry of Environment initiated an inventory of abandoned peatlands and started some peatland restoration initiatives.

(Note: this audit report can be obtained from the WGEA [website](#))

4.2.3. DATABASE ANALYSES

Among the audits reviewed by the Project Team, 30 to 35 percent involved some kind of database analyses. The analyses took different forms, often depending on the availability and quality of the data. For example, some audit teams generated summary statistics from water program data to describe the status of key program components. Other audit teams conducted regression analyses to explain cause-effect relationships.

For water-related audits, the Project Team's analysis found that SAs are also increasingly using Geographic Information Systems (GIS) as a tool to identify changes in water resources or high-risk areas prone to water-related natural disasters, such as erosion, flooding, and drought. GIS is a set of software tools to link data and locations that can show the relationships between different types of information. GIS organizes and stores information as a set of "layers" linked by location. For example, GIS can link together information such as the location of flood prone areas, parcels of land, and the location of different soil types. The Project Team found that the most common use of GIS was to layer different types of information to describe the characteristics of a specific location or area.

⁹¹ Focus Groups are listed as a specialized audit tool, but focus groups can also be used by SAs with limited resources if it is convenient for members to meet in one location or if Internet meetings can be used. In some cases, this method required a trained moderator.

⁹² Unlike expert panels, the Project Team's review of audits found that focus groups generally are not comprised of experts. Instead, focus groups often include various stakeholders whose involvement is necessary for effective program implementation.

FEATURE AUDIT: NORWAY'S OFFICE OF THE AUDITOR GENERAL USED DATA ANALYSIS TO SHOW THE EXTENT OF COMPLIANCE WITH NATIONAL FLOOD PREVENTION DIRECTIVES

In 2010, the Office of the Auditor General of Norway reported on government efforts to limit flood and landslide hazards. The audit's objectives were to determine (1) what mapping of flood and landslide hazards had been performed, and how the information had been disseminated and used by municipalities and (2) how the authorities at different levels ensure that national objectives in the field of floods and landslides are implemented. To help address the objectives, the audit team used a GIS program to conduct a map analysis to identify the scope of the flood and landslide hazards in Norway. The analysis covered flood inundation maps and quick clay maps (e.g., a proxy for landslide risks), as well as susceptibility maps for rockslides and avalanches from the Geological Survey of Norway.

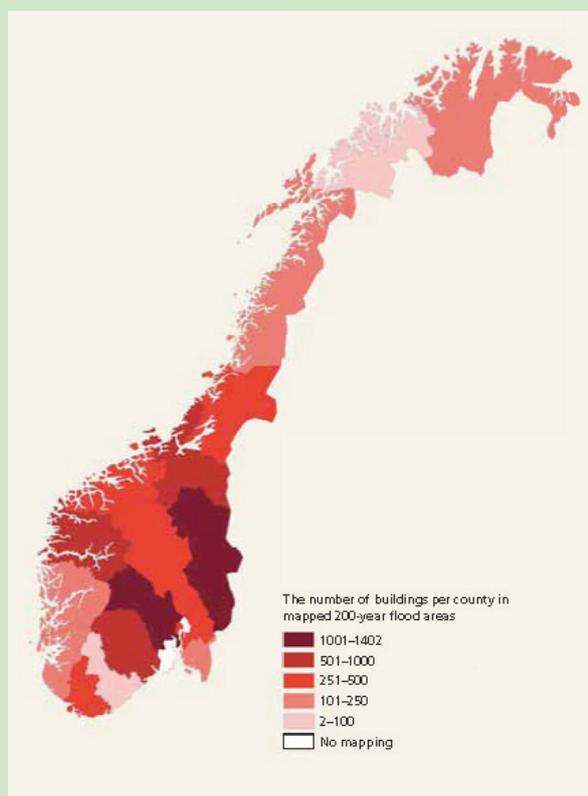
The analysis consisted of three parts: (1) a map survey to obtain an indication of how many buildings and inhabitants there were in the mapped hazard and susceptibility area (see fig. 26); (2) a time series data analysis to identify the development trends in the hazard and susceptibility areas before and after the municipalities were given access to the

government mapping; and (3) in-depth surveys in eight municipalities to establish how they had used the maps.

The report concluded that limiting flood and landslide hazards depends in part on the extent to which government authorities make flood and landslide maps available to municipalities. Through the database analysis, the audit team showed the extent to which national mapping had been completed on flood and quick clay hazards, as well as on the susceptibility of rockslide and avalanche hazards. It pointed out, for example, that at the end of 2008, nearly 160,000 people were living in areas that were potentially at risk from floods and landslides. The audit showed, however, that a number of municipalities were not aware of the mapping that had been carried out by the government agencies, particularly those showing rockslide and avalanche risks.

(Note: this audit report can be obtained from the SAI's [website](#))

Figure 26: GIS Analysis Showing the Number of Buildings per County in Norway within the Area Mapped for 200-year Floods



Source: Office of the Auditor General of Norway; map prepared by the Norwegian Geotechnical Institute.⁹³

⁹³ Office of the Auditor General of Norway, *The Office of the Auditor General's Investigation into the Efforts of the Authorities to Limit Flood and Landslide Hazards*, 2010. (Note: this audit report can be obtained from the SAI's [website](#))

4.2.4. ECONOMIC ANALYSES

Economic analyses were featured in less than 5 percent of the audits reviewed by the Project Team. SAIs used such analyses primarily to determine the optimum use of resources or to compare alternative scenarios in addressing a specific objective.⁹⁴ Economic analyses take into account the opportunity costs of resources employed and aim to measure, in monetary terms, the social costs and benefits of a project to a specified community or to the economy as a whole.

FEATURE AUDIT: SWEDEN'S NATIONAL AUDIT OFFICE USED ECONOMIC ANALYSIS TO HELP EVALUATE GOVERNMENT EFFORTS TO PROMOTE SUSTAINABLE FISHERIES

In 2008, the Swedish National Audit Office issued an evaluation of the central government's efforts on sustainable fisheries. To examine the impact of various financial incentives Sweden had established to support the fishing industry, the audit team performed an economic analysis of data collected by the Board of Fisheries and Statistics Sweden. In particular, this analysis examined whether the financial incentives supporting the fishing industry were well-aligned with the broader goals and objectives of Sweden's fisheries policy. The audit team also consulted with external experts (e.g., academicians) for assistance with the economic analysis and to verify its results.

The analysis showed that, in many cases, the financial support provided to the fishing industry

worked at cross-purposes with the objectives of Sweden's fisheries policy. According to the audit team, the economic analysis proved to be a major source of findings in the report by uncovering areas of policy deficiency and revealing a disconnect between the financial support and incentives given to the fishing industry and the overarching goals of Sweden's fisheries policy. The analysis also benefited greatly from the assistance of a credible, external expert. The expert chosen to assist in this effort was highly regarded and well-respected, and the expert's validation of the results made it difficult to question the National Audit Office's findings and recommendations.

(Note: this audit report can be obtained from the EUROSAI WGEA [website](#))

4.2.5. SCIENTIFIC ANALYSES

Scientific analyses were featured in between 5 and 10 percent of the audits reviewed by the Project Team. Such analyses were used primarily to demonstrate empirical cause-and-effect relationships among program goals and program implementation. For example, as part of an audit looking at the quality of drinking water, the SAI of Chile conducted chemical, physical, and bacteriological testing of water samples to determine whether the water quality adhered to government standards on water for human consumption.⁹⁵ In general, scientific analyses took the form of field experiments, laboratory experiments, and experimental simulations. Of the three, audit teams relied most often on field experiments, which were generally less resource intensive and easier to implement. According to INTOSAI's Performance Audit Guidelines,⁹⁶ field experiments often allow an audit team to compare a group of persons who may be affected by a program to others who have not been exposed to the program. They are generally categorized as true experiments, nonequivalent comparison groups, or before-and-after studies.

⁹⁴ For example, in 2007 the United Kingdom's National Audit Office conducted an economic analysis of the water authority's framework for regulating the supply/demand balance, with a specific focus on the incentives on companies to meet long-term water demand in the most efficient and sustainable way. See United Kingdom National Audit Office, *Ofwat - Meeting the Demand for Water*, 2007. (Note: this audit report can be obtained from the SAI's [website](#))

⁹⁵ Office of the Comptroller General of Chile, *Potable Water for Human Consumption in Rural Localities*, 2003.

⁹⁶ INTOSAI, *Performance Audit Guidelines: ISSAI 3000 – 3100* (Denmark, 2004).

- **True experiments**—the characteristic of a true experimental design is that some units of study are randomly assigned to a treatment group and some are assigned to one or more comparison groups. Random assignment means that every unit available to the experiment has a known probability of being assigned to each group, and that the assignment is made by chance, as in the flip of a coin. The program’s effects are estimated by comparing outcomes for the treatment group with outcomes for each comparison group.
- **Nonequivalent comparison group design**—the main purpose is to answer specific cause-and-effect questions. Unlike the groups in the true experiment, nonequivalent comparison groups are not randomly assigned.
- **Before-and-after design**—units of study are evaluated before their exposure to a program, and compared to outcomes measured on one or more occasions afterward. There is no comparison group as it exists in the other designs.

FEATURE AUDIT: INDIA’S SAI USED SCIENTIFIC ANALYSES TO EVALUATE THE EFFECTIVENESS OF GOVERNMENT PROGRAMS AIMED AT PREVENTING AND TREATING WATER POLLUTION

In 2011, the Comptroller and Auditor General of India issued a report titled, “Performance Audit of Water Pollution in India.” In recent years, various stakeholders had identified water pollution as India’s most important environmental issue of concern. To examine the extent of government oversight over water pollution in India, the audit team used a suite of methods, one of which included working with audit teams in the states to perform field experiments and laboratory testing. The audit reviewed 140 projects across 24 polluted stretches of rivers, 22 lakes and 116 groundwater blocks—standardized areas for water quality monitoring—across 25 states of India.

Audit teams in the states collected water samples at sites downstream from where sewage treatment plants released water into rivers, canals, or lakes. These samples were then sent to laboratories for testing. Where such testing could not be carried out, the audit team used testing reports generated by the managers of the sewage treatment plants, who were required to do such testing. The results obtained after testing were compared with water quality criteria set by the central government. The purpose was to arrive at an independent assessment

of the quality of water in the rivers and lakes after prevention and cleanup measures had been implemented by government programs. According to the audit manager, water quality testing was among the most important methodologies used, because it provided data regarding the impact of government programs for prevention and control of water pollution.

The performance audit revealed that water pollution had not been adequately addressed in India at the national or state level. The scientific analysis helped the audit team reach a number of important conclusions, including that the overall status of water quality and associated risks in rivers, lakes, and groundwater had not been adequately assessed. In addition, the team’s scientific analysis helped it determine that programs for pollution prevention, treatment, and restoration of polluted waters had not been planned, implemented or monitored efficiently and effectively.

(Note: this audit report can be obtained from the SAI’s [website](#))

4.2.6. INTERNATIONAL BENCHMARKING

Among the audits reviewed by the Project Team, approximately 5 percent used international benchmarking as a key component of their methodologies. International benchmarking is a process for comparing a country’s programs, methods, processes, or procedures against those of other countries that consistently distinguish themselves in the same areas. SAIs used benchmarking to (1) prompt an objective review of processes, practices, and systems; (2) develop criteria and identify potentially better ways of operating; or (3) lend more credibility to audit recommendations.

FEATURE AUDIT: UNITED KINGDOM'S NATIONAL AUDIT OFFICE USED INTERNATIONAL BENCHMARKING TO IDENTIFY BEST PRACTICES IN ADDRESSING DIFFUSE WATER POLLUTION

In 2010, the United Kingdom's National Audit Office issued a report titled, "Tackling Diffuse Water Pollution in England." (Additional information on the background, objectives, and results of this audit is available in the chapter 3 "Quality of Rivers, Lakes, and Other Surface Waters" subsection and in figure 17 of this report.) Pollution imposes not only environmental costs through its effects on aquatic life, but also the financial costs of the treatment of water for drinking. The audit team used several sophisticated audit techniques to determine whether the United Kingdom's Environment Agency (1) had a good understanding of the sources of diffuse pollution, (2) was raising awareness among polluters about the problem and how changes in their behaviour and practices can help, and (3) was making good use of incentives and sanctions to change the behaviour and practices of farmers. One notable technique was benchmarking the Environment Agency's current approach to tackling diffuse pollution with the work of its counterparts from other countries within and outside the European Union.

Working with a contractor to complete the international benchmarking exercise, the audit team conducted a literature review of key urban and agricultural initiatives being undertaken in the countries selected for comparison. The literature review helped identify best practices and provided information on whether the Environment Agency had the correct balance in its use of regulation, education and incentives, according to the audit team. The benchmarking process also included interviews and discussions with an expert panel, the European Commission, Water UK, and other stakeholders to help identify international initiatives of interest. According to the audit team, the benchmarking exercise was particularly useful in identifying alternative approaches that the Environment Agency could take, and to determine whether the Environment Agency had actively looked externally for best practices.

(Note: this audit report can be obtained from the SAI's [website](#))

4.3. OBSERVATIONS

The SAI audit experiences described in chapter 3, together with the "Toolbox" presented in this chapter, illustrate the wide variety of analytical methods SAIs have at their disposal to audit the critical water-related issues facing their governments. The diversity in both the issues addressed and the methodological approaches used to address them clearly suggest there is no single best way to audit water-related issues. Nevertheless, two key observations may be drawn.

First, the large majority of water-related evaluations have relied upon a core set of basic audit tools with which most SAIs are comfortable—including interviews, documentation reviews, and site visits. Basic audit tools were used in every water-related audit analyzed for this report and, in most cases, were used in combination to form the foundation of successful audit methodologies. A basic message is clear—whether an SAI is new to performance auditing and is conducting its first water-related audit, or already has considerable experience in performance auditing of water-related issues, these basic audit tools will likely go a long way toward developing compelling findings and observations.

Second, in many cases, the particular questions being investigated or the unique circumstances of an audit have led some SAIs to choose more specialized audit tools to supplement their core methods. The additional resources and technical expertise these tools entail may present challenges for some SAIs. However, in circumstances where applying them is feasible, SAIs have found that they offer considerable added value, particularly when dealing with complex, controversial, or technical topics. Prospective evaluations of alternative policy directions can be particularly challenging to address with basic tools alone, due to their future-oriented focus, a frequent lack of empirical data, and an absence of traditional audit criteria such as laws or regulations. As emerging water problems—such as those associated with climate change—become more pressing and the need for action more urgent, SAIs will likely undertake such evaluations with greater frequency. Specialized audit tools, such as the use of expert panels, international benchmarking, and economic analysis, can help overcome the challenges associated with prospective evaluations and, in doing so, can provide SAIs with greater opportunities to inform their governments' future policies and responsibilities.



APPENDIX I

BIBLIOGRAPHY AND LIST OF INTERNATIONAL WATER-RELATED WEBSITES

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- National Audit Office of Estonia, *Exploitation of Peat Resources*, 2005.
- National Audit Office of Finland, *Reducing Nutrient Emissions from Agriculture*, 2008.
- National Audit Office of the People's Republic of China, *Audit Investigation of Water Pollution Control and Prevention of the Bohai Sea*, 2008.
- National Audit Office of Tanzania, *A Performance Audit of the Management of Prevention and Mitigation of Floods at Central, Regional and Local Levels of the Government of Tanzania: A Case Study of Floods in Babati*, 2007.
- Netherlands Court of Audit, *Drinking Water in Developing Countries*, 2008.
- New Zealand Office of the Auditor-General, *Horizons and Otago Regional Councils: Management of Freshwater Resources*, 2005.
- New Zealand Office of the Auditor-General, *Local Authorities: Planning to Meet the Forecast Demand for Drinking Water*, 2010.
- Office of the Auditor General of Botswana, *Maintenance of Urban Water Supply by the Water Utilities Corporation*, 2004.
- Office of the Auditor General of Botswana, *Performance Audit Report on Fishing Industry in Botswana by Fisheries Division*, 2005.
- Office of the Auditor General of Canada, *Safety of Drinking Water: Federal Responsibilities*, 2005.
- Office of the Auditor General of Canada, *Safety of Drinking Water*, 2009.
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- Office of the Auditor General of Canada, *Adapting to Climate Impacts*, 2010.
- Office of the Auditor General of Norway, *The Office of the Auditor General's Investigation of the Management and Control of Fish Resources in the Barents Sea and the Norwegian Sea – A Parallel Audit Conducted by the Office of the Auditor General of Norway and the Accounts Chamber of the Russian Federation*, 2007.
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- Office of the Auditor General of Norway, *The Office of the Auditor General's Follow-up of the Parallel Audit with the Accounts Chamber of the Russian Federation of the Management of the Fish Resources in the Barents Sea and the Norwegian Sea*, 2011.
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LIST OF INTERNATIONAL WATER-RELATED WEBSITES

- European Commission - http://ec.europa.eu/environment/water/index_en.htm
- Global Water Partnership - <http://www.gwp.org/>
- Intergovernmental Panel on Climate Change (IPCC) - <http://www.ipcc.ch/>
- International Water Management Institute - <http://www.iwmi.cgiar.org/>
- INTOSAI Working Group on Environmental Auditing (WGEA) - <http://www.environmental-auditing.org/Home/FocusonWater/tabid/131/Default.aspx>
- Organisation for Economic Co-operation and Development (OECD) - <http://www.oecd.org/environment/resources/>
- Stockholm International Water Institute (SIWI) - <http://www.siw.org/>
- United Nations Children's Fund (UNICEF) - <http://www.unicef.org/wash/index.html>
- United Nations Convention to Combat Desertification (UNCCD) - <http://www.unccd.int>
- United Nations Development Programme (UNDP) - <http://www.undp.org/water/>
- United Nations Educational, Scientific and Cultural Organization - <http://www.unesco.org/new/en/natural-sciences/environment/water/>
- United Nations Environment Programme (UNEP) - <http://www.unep.org/>
- United Nations Global Environment Monitoring System (GEMS) Water Programme - <http://www.gemstat.org/>
- UN-Water - <http://www.unwater.org/>
- World Bank - <http://water.worldbank.org/water/>
- World Health Organization (WHO) - <http://www.who.int/topics/water/en/>
- World Meteorological Organization - http://www.wmo.int/pages/prog/hwrrp/index_en.html
- World Water Council - <http://www.worldwatercouncil.org/>



APPENDIX II

LIST OF WATER-RELATED AUDITS ANALYZED FOR THIS REPORT

(Note: In some cases, the report titles presented below are approximate English translations from the original publication language)

TABLE 4: LIST OF ANALYZED WATER-RELATED AUDITS BY SAI, INCLUDING LINKS TO THE REPORTS

SAI(s)	Audit Title	Year of Publication	Link to Report ^a
ALBANIA	Report on the Audit Conducted at Ministry of Environment, Forestry and Water Administration, on the Preservation of Ohrid Lake Project	2008	Report (English)
ARGENTINA	Integrated Management Project and Master Plan of the Pilcomayo River Basin	2011	Report (Spanish)
	Management of the Project for Environmental Protection and Sustainable Development of the Guaraní Aquifer System	2007	Report (Spanish)
	The Federal Plan for Flood Control (PFCI)	2007	Report (Spanish)
AUSTRALIA	Drought Assistance	2011	Report (English)
	Restoring the Balance in the Murray-Darling Basin	2011	Report (English)
	Administration of the Water Smart Australia Program	2010	Report (English)
	Management of Domestic Fishing Compliance	2009	Report (English)
	Regional Delivery Model for the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality	2008	Report (English)
	Drought Assistance	2005	Report (English)
	The Administration of the National Action Plan for Salinity and Water Quality	2004	Report (English)
BOTSWANA	Performance Audit Report on Fishing Industry in Botswana by Fisheries Division	2005	Report (English)
	Maintenance of Urban Water Supply by the Water Utilities Corporation	2004	Summary (English)
BRAZIL	Adaptation Measures for Climate Change Scenarios in the Brazilian Coastal Zones	2009	Report (Portuguese) Summary (English)
	Adaptation Measures for Climate Change Scenarios in the Brazilian Semi-arid Region Regarding Water Security	2009	Report (Portuguese) Summary (English)
	TCU Evaluation of the Irrigation and Drainage Program	2003	Summary (English)
BHUTAN	Drinking Water Supply and Sanitation Audit	2011	Report (English)
CANADA	Adapting to Climate Impacts	2010	Report (English)
	Monitoring Water Resources	2010	Report (English)
	Oil Spills from Ships	2010	Report (English)
	Protecting Fish Habitat	2009	Report (English)
	Safety of Drinking Water	2009	Report (English)

^a Links to reports are current as of November 7, 2012.

(Note: In some cases, the report titles presented below are approximate English translations from the original publication language)

TABLE 4: LIST OF ANALYZED WATER-RELATED AUDITS BY SAI, INCLUDING LINKS TO THE REPORTS

SAI(s)	Audit Title	Year of Publication	Link to Report ^a
CANADA	Areas of Concern in the Great Lakes Basin	2008	Report (English)
	Control of Aquatic Invasive Species	2008	Report (English)
	Managing Environmental Programming—Agriculture and Agri-Food Canada	2008	Report (English)
	Drinking Water in First Nations Communities	2005	Report (English)
	Fisheries and Oceans Canada—Canada’s Oceans Management Strategy	2005	Report (English)
	Safety of Drinking Water: Federal Responsibilities	2005	Report (English)
CHILE	Compliance with Environmental Legislation Related to Ship Bilges	2009	Report (Spanish)
	Potable Water for Human Consumption in Rural Localities	2003	N/A
CHINA	Results of a Cooperative Audit of the Prevention and Control of Water Pollution in “Two Rivers and One Lake” Drainage Basins in 2009	2009	N/A
	Audit Investigation of Water Pollution Control and Prevention of the Bohai Sea	2008	Summary (English)
COSTA RICA	Report on the Integral Management of Subterranean Waters in Coastal Zones	2009	Report (Spanish)
	Report on the Management and Coordination of the Costa Rican Water and Sanitation Institute (AyA) with Respect to the Demands on Aqueduct and Sewage Services in the Region of Chorotega, in the Face of a Proliferation of Tourism, Real Estate and Commercial Projects in the Region	2008	N/A
CYPRUS	Water Management: The Serious Reduction of Water Reserves in Cyprus	2008	Report (English)
ECUADOR	Report on the Management of the Regulatory Corporation of Hydrological Operations for the Use and Control of the Poza Honda Reservoir, and the Posterior Treatment of Waste Water Supplying the Potable Water Conveyance for Portoviejo and Various Cities of Manabí	2007	N/A
	The Potable Water and Sewage System Enterprise (EAPAM) for the Manta River	2007	Report (Spanish)
EGYPT	Audit Report on the Extent of Appropriateness and Soundness of Potable Water	Approximately 2001	N/A
ESTONIA	Supervision Over Use of Pesticides and Mineral Fertilizers	2010	Report (Estonian) Summary (English)
	Control of Fisheries in the Baltic Sea	2009	Report (English)

^a Links to reports are current as of November 7, 2012.

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TABLE 4: LIST OF ANALYZED WATER-RELATED AUDITS BY SAI, INCLUDING LINKS TO THE REPORTS

SAI(s)	Audit Title	Year of Publication	Link to Report ^a
ESTONIA	Development of Waste Water Treatment in Rural Areas with the Support of the Cohesion Fund's Projects	2007	Report (Estonian) Summary (English)
	Exploitation of Peat Resources	2005	Report (English)
EUROPEAN COURT OF AUDITORS	Is EU Structural Measures Spending on the Supply of Water for Domestic Consumption Used to Best Effect?	2010	Report (English)
FINLAND	Reducing Nutrient Emissions from Agriculture	2008	Report (Finnish) Summary (English)
	Developing Fisheries	2007	Report (Finnish) Summary (English)
GHANA	Performance Audit Report of the Auditor-General on the Provision of Safe Drinking Water	2006	Report (English)
HONG KONG (SPECIAL ADMINISTRATIVE REGION OF CHINA)	Treatment and Disposal of Sewage Sludge	2007	Report (English)
INDIA	Performance Audit of Water Pollution in India	2011	Report (English)
	Ministry of Water Resources: Functioning of Brahmaputra Board	2010	Report (English)
	Performance Audit of the Accelerated Irrigation Benefits Programme	Approximately 2008 - 2010	Report (English)
	Performance Audit of the Accelerated Rural Water Supply Programme	2008	Report (English)
	Urban and Rural Water Supply Schemes in Haryana	2007	Report (English - Section 3.2)
	Conservation and Management of Dal Lake	2006	Report (English - Section 3.2)
	Performance Audit of Urban Water Supply System in Sikkim	2006	Report (English - Section 3.5)
	Sewerage and Sanitation Schemes Including Yamuna Action Plan	Approximately 2004 - 2006	Report (English)
	Water Management by Panchayat Raj Institutions in Alappuzha District	Approximately 2005 - 2006	Report (English)
	Measures to Control Water Pollution in River Yamuna in Delhi	Approximately 2005	Report (English)
Performance Audit of Arsenic Alleviation Programme	2005	Report (English)	
Audit of the Ganga Action Plan	Approximately 2000	Report (English)	

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TABLE 4: LIST OF ANALYZED WATER-RELATED AUDITS BY SAI, INCLUDING LINKS TO THE REPORTS

SAI(s)	Audit Title	Year of Publication	Link to Report ^a
INDONESIA	Audit Report on the Handling of Disaster in Lake (Situ) Management	2010	N/A
	Audit Report on River Pollution Control Performance	2009	N/A
	Audit Report on Performance of the Handling of Flood Disaster in Watershed	2008	N/A
KUWAIT	The Environmental Impacts Assessment of the Red Tide Phenomenon	2010	Summary (English)
MALAYSIA	A Study on Management of Non-Revenue Water	2010 - 2011	N/A
	A Study on Management of Drinking Water Quality	2008	Summary (English)
NETHERLANDS	Drinking Water in Developing Countries	2008	Report (English)
	Sustainable Fisheries	2008	Report (English)
NEW ZEALAND	Managing Freshwater Quality: Challenges for Regional Councils	2011	Report (English)
	Planning to Meet the Forecast Demand for Drinking Water in Auckland	2011	Report (English)
	Local Authorities: Planning to Meet the Forecast Demand for Drinking Water	2010	Report (English)
	Department of Conservation: Administration of the Conservation Services Programme – Follow-up Audit	2005	Report (English)
	Horizons and Otago Regional Councils: Management of Freshwater Resources	2005	Report (English)
NORWAY	The Office of the Auditor General's Investigation into the Efforts of the Authorities to Limit Flood and Landslide Hazards	2010	Report (English)
	The Office of the Auditor General's Study of the Management of Fish Resources	2004	Report (English)
	The Office of the Auditor General's Study of the Authorities' Efforts to Clean Up Polluted Ground and Sediments Caused by Polluting Activities in Bygone Years	2002	Report (English)
	The Office of the Auditor General's Investigation of Norway's Compliance with the OSPAR Convention within Industry, Waste Water Management and Agriculture	2000	Report (English)
PARAGUAY	A Special Examination of the Secretary of the Environment (SEAM), in the Municipality of San Antonio and the Central Governance Department, Verification of the Management of the Environmental Setting of the Guazú Stream in the Area Surrounding the "Las Garzas" Housing Development in the District of San Antonio	2007	Report (Spanish)

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SAI(s)	Audit Title	Year of Publication	Link to Report ^a
RUSSIA	Audit of the Efficiency of the Water Resources Organization and Management in the Russian Federation	2006	N/A
SLOVAK REPUBLIC	Governance of Public Funds Allocated for Flood Protection and Elimination of the Consequences	2011	N/A
SOUTH AFRICA	Report of the Auditor-General on a Performance Audit of the Provision of Sanitation Services at the Department of Water Affairs and Forestry	2008	Report (English)
SOUTH KOREA	Environmental Audit on the Water Quality Improvement Projects: Four Major Rivers of Korea	Approximately 2001	N/A
SUDAN	The Environmental Impact of Water in Khartoum State	Approximately 2005 - 2007	N/A
SWEDEN	The Central Government's Actions for Sustainable Fisheries	2008	Report (English)
TANZANIA	A Performance Audit of the Management of Prevention and Mitigation of Floods at Central, Regional and Local Levels of the Government of Tanzania—A Case Study of Floods in Babati	2007	Report (English)
THAILAND	Audit of Coastal Erosion Management and Protection	2008	N/A
TURKEY	Performance Audit Report: The Planning and Audit of the Coastal Utilization	2006	Report (English)
	Preventing and Dealing with Pollution from Ships at Sea and in Ports	2002	Report (English)
UNITED KINGDOM	Tackling Diffuse Water Pollution in England	2010	Report (English)
	Adapting to Climate Change	2009	Report (English)
	Building and Maintaining River and Coastal Flood Defences in England	2007	Report (English)
	Ofwat – Meeting the Demand for Water	2007	Report (English)
	Environment Agency: Efficiency in Water Resource Management	2005	Report (English)
	Department for International Development: Maximising Impact in the Water Sector	2003	Report (English)
UNITED STATES OF AMERICA	Energy-Water Nexus: A Better and Coordinated Understanding of Water Resources Could Help Mitigate the Impacts of Potential Oil Shale Development	2010	Report (English)
	Drinking Water: Experts' Views on How Future Federal Funding Can Best Be Spent to Improve Security	2003	Report (English)

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SAI(s)	Audit Title	Year of Publication	Link to Report ^a
COLLABORATIVE AUDITS INVOLVING TWO OR MORE SAIs	Parallel Audit Report on Management of Mangrove Forest in the Strait of Malacca (Indonesia and Malaysia)	2011	N/A
	Joint Final Report on the Audit of Environmental Monitoring and Fisheries Management and Control in the Baltic Sea (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia, and Sweden)	2009	Report (English)
	International Coordinated Environmental Audit Report: The Colombo-Peruvian Plan for the Integral Development of the Putumayo River Basin (PPCP) 1998-2008 (Colombia and Peru)	2008	Report (Spanish)
	The Office of the Auditor General's Investigation of the Management and Control of Fish Resources in the Barents Sea and the Norwegian Sea: A Parallel Audit Conducted by the Office of the Auditor General of Norway and the Accounts Chamber of the Russian Federation (Norway and Russia)	2007	Report (English) Summary (English)
	Joint Report on the Results of the Parallel Audit of Implementation of the Agreement on Transboundary Water Issues Signed By the Government of the Slovak Republic and the Government of Ukraine (Slovak Republic and Ukraine)	2007	Report (English)
	Environmental Audit Report on the Three-Border Area of Hungary, Slovenia and Austria (Austria, Hungary, and Slovenia)	2006	Report (English)
	Joint Report on Auditing Implementation of Flood Protection Measures on Transboundary Waters of Ukraine and Republic of Poland (Poland and Ukraine)	2006	Report (English)
	Audit of the Flood Control Preparedness in the Upper Tisza Region (Hungary and Ukraine)	2005	Report (English)
	Coordinated Audits of Implementation of Tasks Related to Environmental Projects and Measures in the Thaya River Basin (Austria and Czech Republic)	2005	Report (English)
	Joint Final Report on Audit of Implementation of Provisions of the Convention on the Protection of the Marine Environment of the Baltic Sea Area (The Helsinki Convention): Pollution from Ships in the Baltic Sea (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, and Russia)	2005	Report (English)

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www.environmental-auditing.org